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Blockchain Post-Implementation Analysis in Reverse Logistics from a Strategic Alignment Lens

Short Paper

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Abstract

Blockchain technology (BCT) has the potential to transform strategic alliances for reverse logistics, yet its specific impact on sustainability remains unclear. This study aims to ascertain the post-implementation impact of BCT-based strategic alliances on information technology reverse logistics. Drawing on a qualitative research design, it presents a preliminary understanding of BCT-based strategic alliances (i.e., collaborations) in reverse logistics. To address this study's research question, a conceptual framework based on a prior literature review is proposed to guide qualitative data collection. Next, the study analyzes the respondents' voices considering the dynamic capability perspective. Sustainability realization is viewed as the main driver for reverse logistics alliances, and the study explores these alliances' capabilities for sustainability through BCT technology. The study findings significantly contribute to the BCT literature in reverse logistics by assessing BCT-based strategic alliances in reverse logistics and realizing sustainability.

Keywords: BCT, reverse logistics, strategy, alliances, information technology, capabilities

Introduction

Reverse logistics—the process of creating, implementing, and managing an effective flow of products from the consumption point to the source of origin to restore the value or proper disposal of the products or components (Liao, 2018)—has attracted considerable attention due to its benefits for sustainable development (Moktadir et al., 2020). Reverse logistics has been the subject of numerous studies conducted to address sustainability issues such as the existing lack of resources, environmental concerns, increased social responsibility, environmental legislation, and market shifts (e.g., Agrawal et al., 2015). The importance of reverse logistics can be exemplified by considering how the improper handling of a product at the end of its useful life carries the potential to create a toxic hazard to humans (Alarcón et al., 2021), which can adversely affect not only the local environment but the entire ecosystem at the site of disposal (Hanafi et al., 2008). As a result of global acknowledgment of such critical issues, businesses are now working to incorporate reverse logistics into their supply chain activities as a vital step in lowering their ecological footprint (M. T. Islam & Huda, 2018). The global nature of today's logistics has made supply chains more complicated than ever (Difrancesco et al., 2021). The intricacies of reverse logistics, such as sustainable business practices and consumer satisfaction, are facing challenges due to a lack of visibility, logistic inefficiencies, and collaborations (Paula et al., 2020). Such challenges have led businesses to explore cutting-edge innovative solutions like blockchain technology (BCT), which has evolved as a transformative force that has broadened the possibilities for improved traceability, transparency, and cooperation in logistics operations (Sangari & Mashatan, 2022).

Scholars have also recognized and emphasized BCT's capacity to improve reverse logistics operations (Bajar et al., 2022). Recently, Samadhiya et al. (2023) systematically identified various BCT software systems, such as Hyperledger Fabric and smart contracts, and backup peer system, which are either already being used or proposed for future use in reverse logistics dimensions. In practice, BCT applications' advantages are also being increasingly witnessed through more and more applications. For example, the Plasticbank BCT application has been posited to enhance plastic recycling volume by incentivizing waste collectors (plasticbank, n.d.). Similarly, the Circularise platform is leveraging BCT to provide digital product passports for industrial supply chains that can enable composite material circularity at its end of life (Leon, 2023). Moreover, this technology has the potential to make reverse logistics more resilient (Kazancoglu et al., 2023), for example by strengthening product traceability in a way that assists in identifying fraud in both forward and reverse logistics (Difrancesco et al., 2022). Further, a decentralized and encrypted BCT structure guarantees the accuracy, reliability, speed, and availability of reverse logistics data that is shared with numerous stakeholders (Dasaklis et al., 2020) and thus can provide significant benefits for apprising and encouraging stakeholders' behavior in adopting reverse logistics. Recent research findings have anticipated that manufacturers can employ BCT technology to build consumer trust, create a way to trace the reverse recycling of used goods, and modify the actual recycling rate of used products (Ma et al., 2022). For example, BCT enables customers' authorization to participate actively in a closed-loop supply chain (i.e., reverse logistics; Tozanlı et al., 2020). Such active participation can remove consumer reluctance to purchase refurbished products by providing them with information about how their products were manufactured, responsibly sourced, and safely conserved (De Giovanni, 2022; Tozanlı et al., 2020). Studies have also focused on offering technologically collaborative solutions for sustainability in a variety of sectors, such as automotive, food, and health (Hastig & Sodhi, 2020; Köhler et al., 2022; Spanò et al., 2021). These findings highlight the benefits of BCT technology, which connects customers' needs with the supply chain partners' goals, leading to the development of sustainable reverse logistics practices that may be sustained in the long term (Dasaklis et al., 2020).

However, as the application of BCT in reverse logistics is a field in its infancy, discussions regarding its promising potential are also accompanied by doubts and concerns. While exploring the varied avenues for BCT applications in reverse logistics, several studies have identified various barriers to its adoption that span from technological to strategic in nature. These include innovation radiance, technological capabilities, collaboration, implementation risk (Joshi et al., 2023), scaling of technology, regulatory uncertainty, high cost (Govindan, 2022), improper handling of bulk orders, technology a synchronization, partner cooperation problems, and lack of strategic planning (Panghal et al., 2023). Overcoming these challenges requires strategic approaches to BCT adoption that have the potential to benefit stakeholders and enable well-informed investment decisions (Panghal et al., 2023). However, a careful literature analysis reveals a blatant focus on the technical details of BCT's design and implementation in reverse logistics (Centobelli et al., 2022; Saxena & Sarkar, 2023; Xu et al., 2023) while neglecting its post-implementation effects on businesses and strategic alliances. For example, studies have focused on conceptualizing the benefits and difficulties of BCT adoption rather than on examining the technology's actual effect on the businesses adopting BCT (Difrancesco et al., 2022) and their strategic alliances.

A strategic alliance is a potent mechanism whereby two or more parties decide to collaborate to pursue a set of goals while maintaining their independence (Johnson et al., 2014; Mowery et al., 1996). BCT has opened new channels for collaboration and optimized operations in managing strategic alliances by providing safe and transparent transactions (Abdollahi et al., 2023). A recent study established the Strategic Alliance for BCT Governance Game to demonstrate how BCT concepts may be actively applied to improve network security and effectiveness (Kim, 2022). However, it is still unclear in both research and practice literature how precisely BCT-based strategic alliances are shaping sustainable reverse logistics. Recent studies have also emphasized the critical need to examine how BCT's technical advantages interact with business-related outcomes and their strategic needs (Onjewu et al., 2023), such as inter-organizational trust in strategic alliances (Chen et al., 2023). This underscores the need for exploring the post-implementation effects of BCT-based strategic alliances in reverse logistics. This study aims to address this need through the following research question (RQ). RQ: How do BCT-based strategic alliances contribute to the development and performance of sustainable reverse logistics practices?

The study leverages a qualitative research design to address the RQ. The respondents for the data collection will be identified from available industry databases using snowball sampling, with the aim of collecting data from 30–50 respondents. The findings potentially offer a twofold contribution. First, this study highlights a significant recent phenomenon—BCT-based strategic alliances—and elaborates on the possible repercussions for businesses. As prior BCT literature is deeply ingrained in emphasizing BCT adoption and the technical issues affecting the same, this study broadens the scope of discussion on BCT to focus on its post-implementation effects. Through the findings, perspectives are presented on a new form of infrastructure for strategic alliances in reverse logistics. Second, with an emphasis on sustainability outcomes, the study findings will show how BCT-based strategic alliance advantages might be realized, thus paving the way for prospective scholarships on BCT-based sustainability solutions and strategic alliance mechanisms. The findings will offer insights to businesses focusing on optimizing reverse logistics performance as they search for innovative approaches by employing solutions like BCT.

Theoretical Background

BCT in reverse logistics

BCT possesses the ability to transform and revamp the supply chain stakeholders' interactions (H. Subramanian, 2017). Scholars have demonstrated that BCT can have an impact on reverse logistics by increasing its efficiency, lowering costs, strengthening eco-friendly initiatives, and carrying out proper documentation (N. Subramanian et al., 2020). Prior literature discoursing BCT applications in reverse logistics has touched upon a myriad of issues. There are also systematic reviews that primarily discuss and determine the difficulties associated with reverse logistics. For example, Govindan (2022) discussed BCT adoption challenges in remanufacturing for achieving sustainable development goals, while Khan et al. (2021) proposed BCT as a solution for promoting circular economy practices to assist businesses in improving their environmental performance specifically and their organizational performance in general. Moreover, scholars have also suggested using BCT in conjunction with other technologies like the Internet of Things (Hrouga et al., 2022). Scholars contend that the concurrent and complementary use of these technologies has the potential to offer a safe method of transporting items from the producer to the customer and reducing damage in reverse logistics (Dutta et al., 2023). Further, a few prior scholars have explored BCT with regard to incentive systems that could encourage reverse logistics. For example, giving collectors incentives can lead to BCT yielding a greater impact on the closed-loop supply chain (Govindan, 2022). A BCT smart contract can ensure that businesses and collectors are aligned in the management of closed-loop supply chain operations since collectors only earn incentives when they complete collections effectively. In a recent study, Li et al. (2023) developed and tested a token incentive system in response to extended producer responsibility (EPR)[1], and their results showed that the governments' provision of tokens increased consumer economic incentives. It increased recycling costs for uncredited recyclers, and thus consumers were encouraged to resell their used products to authorized recyclers. Although BCT is acknowledged as an automated governance mechanism by enforcing the agreements through its computational and database capabilities (Lumineau et al., 2021), the incentive-based system further ensures the success of this mechanism. Additionally, BCT reduces the risk of fraud in reverse logistics by tracking a material's origin, composition, and validity. BCT's features for enhancing transparency, traceability, and immutability can significantly reduce the risk of fraud in product returns, which typically involves returning a different product from the one that was initially purchased (Difrancesco et al., 2022). Based on these findings, Figure 1 clarifies the suitability of BCT for reverse logistics operations.

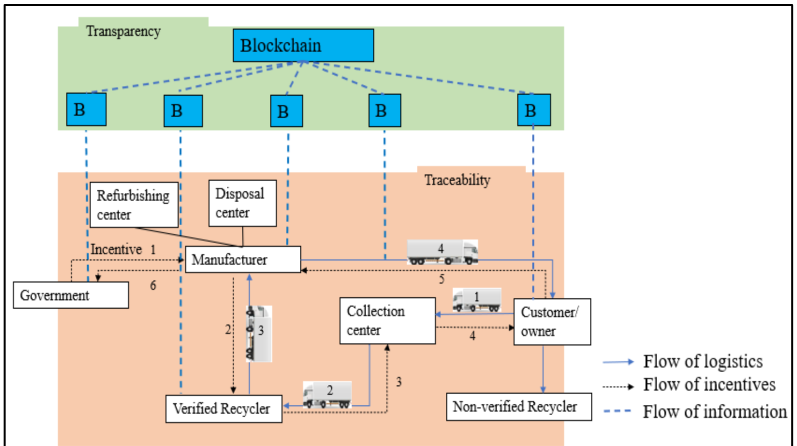

Figure 1: BCT utilization in reverse logistics (Source: Authors)

BCT and strategic alliance

Traditional strategic alliance management, which may last several years from inception to maturation, strives to preserve a partner relationship for optimal benefits (He et al., 2020). In traditional reverse logistics, strategic alliances have been acknowledged for lowering recycling costs and are more professional and effective than self-owned reverse logistics (Zhou & Zhou, 2015). Additionally, to deliver products that have a lower cost, higher quality, and better environmental performance, businesses need to form strategic alliances while also meeting customer expectations in terms of social responsibility and sustainability (He et al., 2020; Pinto, 2020). However, the nature and workings of strategic alliances are changing because of digital transformation. Instead of focusing only on resources, digitization-driven strategic alliances prioritize innovation facilitation and utilize disruptive technologies for developing innovative products, including digital integration (Bustinza et al., 2019). In the wake of such digital transformation, organizations must reexamine their traditional relationship coordination and interfirm collaboration to adjust to changing partner expectations, qualities, and requirements (Bouncken & Fredrich, 2016).

Advanced information and communication technologies such as BCT smart contracts are leading to the emergence of agile, flexible, and even ad-hoc virtual collaboration with significantly shorter life cycles (Kohtamäki et al., 2018). BCT application in strategic alliances is thought to assist the growth of trust-based collaboration among partners due to its precise and irrefutable transaction records, advantages, and contributions (Chen et al., 2023). Indeed, prior literature exploring BCT technology in the supply chain has recognized business collaborations as pivotal in BCT-based relationships between firms (Samadhiya et al., 2023). For example, Difrancesco et al. (2022) suggest that implementing BCT can assist managers in structuring and improving their network relationships with supply chain partners and improve collaborations. Moreover, scholars investigating reverse logistics' connotations for sustainability have emphasized worldwide industry collaboration as a key component of setting up global BCT standards to

[1] EPR is a policy approach that holds producers responsible for the collection and proper disposal of their post-consumer goods.

facilitate widespread adoption (Samadhiya et al., 2023). The above discussion clearly shows that BCT applications, particularly in reverse logistics, can have significant implications for establishing and improving strategic alliances. Hence, this study turns its focus to exploring BCT-based strategic alliances and examining the nuances of this technology's contribution to such alliances in reverse logistics by considering the dynamic capability perspective.

The dynamic capability perspective

Prior literature has taken the support of several theoretical grounds to explore the nuances of strategic alliances. The most prominent theories in this area include the knowledge-based view of the firm (Grant, 1996), social capital theory (Koka & Prescott, 2002), and the resource-based view of the firm (Barney, 2001). However, the dynamic capability theory (Teece et al., 1997) has not been used much in this area. The dynamic capability theory suggests that, while maintaining continuous improvement, businesses can rely on their external and internal competence in the processes of integration, development, and reconfiguration by taking into account the dynamic nature of the changes that organizations face from the environment (Teece et al., 1997). Dynamic capabilities are important factors in determining business performance (Eisenhardt & Martin, 2000). The capabilities that a business possesses can be categorized in terms of seizing and shaping opportunities, sensing threats, and pursuing competitive advantage by reconfiguring and transforming the intangible and tangible resources of the organization (Teece, 2007). This framework explains the strategies required to ensure that an opportunity, once sensed, is captured through business/process transformation while emphasizing the process's efficiency for achieving the target outcome through strategic alliance. Thus, the dynamic capability framework surpasses conventional approaches to understanding a firm's capability to manage strategic alliances in the emerging technological environment, and the capacities of sensing, seizing, and transforming lay at its core (Schilke, 2014). The ability of strategic alliances to learn more quickly and effectively than an individual firm by utilizing partner synergy as well as changing circumstances can be better understood by adopting the dynamic capabilities perspective (Schilke, 2014). The dynamic capability view is a suitable theory for this study considering that we are in a period of technological disruptions (He et al., 2020) that require businesses to be aware of and adaptable to the various opportunities and threats raised by technological disruption, such as the dynamically competitive landscape, changing customer preferences, emerging technology applications, and new government regulations to modulate and govern them. Strategic alliances are posited to enhance dynamic capabilities by allowing an increasing number of businesses to acquire desired resources and information that would otherwise be out of reach (Fang & Zou, 2009). This study emphasizes that investigating how BCT applications are dynamically shaping the capabilities of businesses and their strategic alliances is the need of the hour. In this regard, the dynamic capability view can offer significant value-based insights on the pathways through which firms develop capabilities from their strategic alliances post-BCT implementation. The proposed conceptual framework for this study, developed by leveraging this theory, is presented in Figure 2.

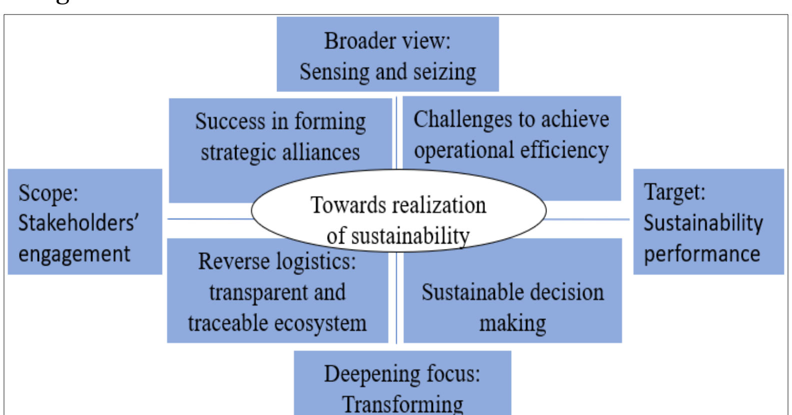

Figure 2: Proposed research framework

Methodology

Research design and context

This study uses a qualitative research design and open-ended essays to gain a deeper understanding of how BCT-based strategic alliances are yielding fruit in reverse logistics. The study is conducted against the backdrop of the electronics industry—a core sector of the information technology industry. This is a viable industry for this study as electronic equipment utilization has grown exponentially in the current technology-driven era. Scholars have noted e-waste as one of the increasing solid wastes, with an estimated average annual growth rate of 4–6% (M. N. Islam et al., 2016). As compared to other industrial waste streams, this e-waste consists of not only valuable material that could be reused but also hazardous metals. The improper disposal of these metals is a significant threat to the environment and poses a considerable danger to human health. Thus, it is critical for businesses in the electronics industry to undertake the proper recycling of materials (Dias et al., 2018), which further emphasizes the importance of reverse logistics in this industry. The focus on this sector also answers a recent call for greater attention to resolving sustainability issues in waste electrical and electronic equipment (WEEE; Joshi et al., 2023). Prior evidence suggests that the total volume of e-waste in 2019 was 53.6 million tons, with an annual increase of about 2.5 million tons (Forti et al., 2020). While this is an alarming number, it is also unsurprising considering the increased consumption of electronic gadgets and devices on account of rapid advancements in technology, increasing household wealth, urbanization, the early disposal of useful products, and the shortening of the life span of products, all of which are posited to be significant reasons for WEEE (Koshta et al., 2021). Thus, this study contends that examining BCT applications for sustainable reverse logistics in the electronics industry can yield valuable insights, particularly considering strategic alliances.

Data collection and analysis

The data will be collected through a predetermined set of open-ended essay questions that will encourage respondents to discuss their experiences with BCT technology in reverse logistics. The essay questions are designed to facilitate conversational responses while also exploring the characteristics, key alliances, business environment, products, decision-making procedures, sustainability performance, and BCT implementation of the respondents' firms. The study will include 30–50 respondents, and the context will be limited to Europe as a recent report (Data Bridge Market Research, 2022) indicates that the continent's reverse logistics market is anticipated to grow at a growth rate of 4.7% till 2029, reaching a value of $2.2 million U.S. dollars. This study thus contends that Europe is an appropriate study context.

To identify the most relevant respondents, a screening survey is planned to ensure that respondents are involved in reverse logistics operations and have knowledge of BCT. These respondents will be primarily identified through available industry databases and snowball sampling. Their suitability will be ensured by asking them about their role in reverse logistics and BCT, their use experience/know-how, and so on. Subsequently, shortlisted respondents will be asked the relevant questions for data collection. The screening survey will be shared with over 200 supply chain managers in Europe, with the aim of identifying approximately 50 respondents for the main study. Further, 30 participants from the screening survey will be identified as supplementary potential respondents in case theoretical saturation for the main analysis is not achieved with 50 planned respondents. Thematic analysis will be utilized to analyze qualitative data. In the analysis, the data will be codified in three phases—as a first-order concept, second-order theme, and aggregate dimensions (Gioia et al., 2013)—to ensure that the findings appropriately reflect respondents' voices while illuminating the main themes of discussion explicated from the analysis.

Expected findings

Leveraging the dynamic capability perspective, this study considers sustainability realization as a primary motivator for cultivating and developing capabilities in reverse logistics processes through BCT-based alliances. The analysis is expected to highlight valuable insights along four main themes. First, the study expects to explain how BCT-based strategic alliances enable businesses to sense and seize potential opportunities to develop critical dynamic capabilities and productive collaborations for sustainable reverse logistics practices, for example through agreed-upon consensus mechanisms. Second, the results are expected to bring attention to varied challenges (operational, structural, or technological) that may impede the effective utilization of BCT-based alliances for reverse logistics, for example in terms of improving the efficiency of sustainability-related initiatives. Along the same line, a clear view of the available (and potential) solutions that could be deployed to counter such challenges is also anticipated. Third, the findings are expected to reveal how and to what extent BCT-based alliances can foster traceable and transparent reverse logistics ecosystems, bringing visibility and resilience to sustainability-related initiatives. Lastly, the study observations are projected to showcase how and to what degree BCT-based alliances influence sustainability-related decision-making. BCT's features are expected to prominently figure in respondents' discussions regarding more effective decision-making, for example, by explaining how access to reliable and current information on shared activities allows a business to make informed decisions without external influence. These anticipated results will provide a thorough understanding of BCT's contribution to building viable strategic alliances with dynamic capabilities for promoting sustainable reverse logistics practices and improving sustainability performance.

Conclusion

This study expands the scope of discussion on BCT's contribution to consider its post-implementation contributions to building strategic alliances for promoting sustainable reverse logistics practices through a qualitative investigation of professionals working in the electronics industry. It offers detailed insights into BCT-based strategic alliances' focus on seizing market opportunities—especially considering consumer demands for sustainability—and building dynamic capabilities that foster effective resource utilization for improving reverse logistics and sustainability performances. The findings are expected to broaden the theoretical foundations in the fields of reverse logistics, strategic management, and sustainability, allowing professionals to understand how BCT-based strategic alliances can improve a business's sustainability performance. The obtained observations can also provide future research guidelines for academic scholars to delve deeper into the contributions that technology-assisted business practices and strategic management of the same can make in fostering a climate of sustainability. In future, scholars are suggested to focus on gathering and analyzing longitudinal and experimental data from professionals in other industries and sectors with budding as well as established reverse logistics processes to improve the extant understanding of BCT-based strategic alliances. Such work will deepen this study's findings and pave the way for prospective scholarship proposing BCT-based sustainability solutions derived from strategic alliance mechanisms.

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