Blockchain technology application in recycling chains: a multiple-case study

Shenghao Xie [a], Yu Gong [a], Martin Kunc [a], Steve New [b]

[a] Southampton Business School, University of Southampton

[b] Saïd Business School, University of Oxford

Purpose: Blockchain technology (BCT) is seen as a disruptive technology to revolutionize operations and supply chain applications (Babich and Hilary, 2020; Hastig and Sodhi, 2020). Extending the traditional supply chain, BCT shows tremendous potential for sustainable performance, especially in tackling the increasing recycling crisis (Gong et al., 2022; Xie et al., 2022). However, much of the current debate on BCT in sustainable supply chain management (SSCM) and recycling remain conceptual and lacks empirical evidence from real-life implications (Saberi et al., 2019). This study is motivated to explore practical use cases of BCT applications in recycling chains via a multiple case study approach.

Design/methodology/approach: This study explores three pioneer cases embracing BCT in recycling chains and the unit of analysis is the BCT use case project, with more than 30 semi-structured interviews of involved multiple stakeholders. The theoretical case sampling method is adopted according to Eisenhardt (1989), with the basis of theoretical replication. The case selection criteria are as follows: 1) must implement the BCT application as the core business function rather than other smart waste management solutions; 2) must engage multiple recycling chain partners and be able to provide research access; 3) must be in the operational phase rather than in the concept or pilot phase. We collected data during 2020-2022, which consisted mainly of semi-structured interviews (in Chinese and English, ranging from 30-150 minutes), field visits, archival data and internal company reports.

It is an iterative process following the coding procedure by Gioia et al. (2013), including within-case analysis and cross-case analysis (Gong et al., 2018). In within-case analysis,

we first comprehend the application context of each case, i.e. recycling chain configuration, information processing needs and BCT-enabled information processing capabilities. In cross-case analysis, we compare the common patterns and operational differences of these cases. The aim of this phase is to categorize open codes, construct theoretical constructs and eventually aggregate dimensions to build the midrange theoretical framework.

Findings: By applying the organizational information processing and boundary theory, we found that BCT offers information processing capabilities of immutability, integration, transparency, and trust to tackle recycling chain-specific uncertainties. Also, BCT serves as the boundary object to enable knowledge integration. The findings demonstrate that BCT can be naturally embedded in the recycling chain scenario. The most important function are tracking recycling flows to demonstrate transparent recycling chains (Chaudhuri et al., 2022, Xie et al., 2022). In BCT implementation stages, the three cases show an iterative knowledge integration process of transferring, translating, and transforming.

Depending on the type of BCT, the cases show different governance mechanisms, with coordination and control mechanisms to govern the participation of members. Specifically, the current governance approach is still dominated by the control of key members such as focal companies or business clients, who enjoy a high level of authority over data visualization, while the coordination is cross-organizational (i.e. recycling chain members) (Goldsby and Hanisch, 2022). Moreover, the value creation can match the demands of different members and even achieve network benefits, which may engage multi-tier actors and external collaboration (Gong et al., 2022, Xie et al., 2022).

Relevance/contribution: Theoretical implication: This study enriches the empirical research on recycling chains, especially as the main literature currently focuses on sustainable or circular supply chains. it expands on the current lack of empirical research on BCT in SSCM and the governance and trust mechanisms associated with BCT, as most discussions are still in a conceptual framework (Xie et al., 2022). In

addition, this study responds to the call by Erhun et al. (2021) on technological solutions to drive sustainable Triple-A supply chains.

Managerial implication: This study demonstrates an innovative recycling business model for practitioners. Also, it offers practical governance strategies for real BCT projects. More importantly, it calls the urgent action to tackle the global recycling and sustainability crisis.

Keywords: blockchain technology, recycling chain, case study, information processing, boundary object

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