Amanollahnejad, Albert ORCID logoORCID: https://orcid.org/0000-0003-4258-6794, Izadi, Javad and Zaghmout, Bilal ORCID logoORCID: https://orcid.org/0000-0001-6296-9608 (2026) Exploring blockchain for green logistics: how institutional forces and process innovation shape sustainability in SMEs. Journal of Enterprise Information Management. pp. 1-27.

Downloaded from: https://ray.yorksj.ac.uk/id/eprint/13950/

The version presented here may differ from the published version or version of record. If you intend to cite from the work you are advised to consult the publisher's version: https://doi.org/10.1108/JEIM-07-2025-0655

Research at York St John (RaY) is an institutional repository. It supports the principles of open access by making the research outputs of the University available in digital form. Copyright of the items stored in RaY reside with the authors and/or other copyright owners. Users may access full text items free of charge, and may download a copy for private study or non-commercial research. For further reuse terms, see licence terms governing individual outputs. Institutional Repositories Policy Statement

RaY

Research at the University of York St John

For more information please contact RaY at ray@yorksj.ac.uk

Amanollahnejad, Albert, Izadi, Javad and Zaghmout, Bilal (2026) Exploring blockchain for green logistics: how institutional forces and process innovation shape sustainability in SMEs. *Journal of Enterprise Information Management.*
https://doi.org/10.1108/JEIM-07-2025-0655

*'This author accepted manuscript is deposited under a Creative Commons Attribution Non-commercial 4.0 International (CC BY-NC) licence. This means that anyone may distribute, adapt, and build upon the work for non-commercial purposes, subject to full attribution. If you wish to use this manuscript for commercial purposes, please contact* ***permissions@emerald.com****.'*

# Exploring Blockchain for Green Logistics: How Institutional Forces and Process Innovation Shape Sustainability in SMEs

**Purpose:**
This study explores how small and medium-sized enterprises (SMEs) interpret and respond to institutional pressures in relation to blockchain-enabled process innovation within green logistics. It examines how coercive, normative, and mimetic pressures are perceived by SMEs and how these pressures intersect with internal process capabilities in sustainability-oriented logistics practices.

**Design/methodology/approach:**
An exploratory qualitative research design was adopted, involving semi-structured interviews with 18 participants, comprising 12 SME consultants and 6 SME directors based in the UK. Supplementary secondary data from industry reports and consultancy materials were used for contextual triangulation. Data were analysed using thematic analysis, guided by institutional theory and business process management (BPM) as interpretive lenses.

**Findings:**
The findings suggest that coercive, normative, and mimetic pressures are widely perceived as shaping SMEs' engagement with blockchain in green logistics. However, participants reported notable variation in how these pressures are prioritised, influenced by firm size, resources, sectoral context, and internal processes. Blockchain was viewed as a tool for transparency, not transformative solution.

**Practical implications:**
The study suggests that SME managers and advisors should therefore view blockchain adoption as part of an incremental process transformation, rather than a purely technological intervention, while policymakers may consider reducing regulatory uncertainty and supporting skills development to lower adoption burdens.

**Originality/value:**
This study contributes an exploratory, context-sensitive account of blockchain adoption in green logistics by integrating institutional theory and BPM as interpretive frameworks. Rather than advancing causal claims, it offers nuanced insight into how institutional pressures and organisational conditions are jointly understood by SMEs.

**Keywords:**
Blockchain technology; Green logistics; Sustainability; Institutional Theory; Business Process Management

## 1. Introduction

The integration of sustainability into business strategy has become fundamental, marking a significant transformation in how companies view their obligations toward environmental stewardship, social well-being, and enduring economic viability (Dyllick & Hockerts, 2002; Kabeyi & Olanrewaju, 2022; Elkington, 1997; Popkova et al., 2023; Weiland et al., 2021; Sharma et al., 2025). Small and medium-sized enterprises (SMEs) are increasingly expected to not only comply with regulatory requirements but also align with the evolving expectations of customers, supply chain partners, and industry peers (Behl et al., 2024; Chavalala et al., 2024; Zhou et al., 2023; Kamewor et al., 2024; Ouni & Ben Abdallah, 2024; Nayak & Dhaigude, 2019). While this shift presents new opportunities for innovation and market access, it also poses significant challenges for SMEs, which often have limited resources, fragmented supply chains, and less capacity for complex compliance processes (Biswas et al., 2023; Fang et al., 2025; Jibril et al., 2024; Varma et al., 2024; Jain et al., 2020; Singh et al., 2024).

In this evolving landscape, blockchain technology (BCT) is heralded as a disruptive enabler of green logistics and sustainable business process innovation (Fang et al., 2025; Popkova et al., 2023; Upadhyay et al., 2021; Wu & Tran, 2018; Sharma et al., 2025; Christodoulou et al., 2024). Green logistics is a particularly suitable domain in which to explore BCT because logistics activities including transportation, warehousing, packaging, and carbon monitoring require high levels of transparency, traceability, and data integrity, areas in which BCT is commonly perceived to offer advantages over other digital tools (McKinnon, 2010; Bag et al., 2023; Moatari-Kazerouni et al., 2024; Sharma et al., 2025). Green logistics broadly refers to the integration of environmentally responsible practices into logistics and supply chain operations, including strategies such as reducing carbon emissions, optimizing transport routes, adopting eco-friendly fuels, minimizing waste, and ensuring transparent sustainability reporting across supply networks (Dekker et al., 2012; McKinnon, 2010).

Recent research reinforces blockchain's transformative role in logistics and supply chains: blockchain adoption is associated with reductions in information asymmetry, enhanced transparency, and improved governance and traceability in complex supply networks, including agribusiness and real estate (Purusottama & Hasudungan, 2025; Spiga et al., 2024; Sharma et al., 2025; Singh et al., 2024). For SMEs, blockchain has been described as facilitating practical solutions such as automated carbon accounting, digital certifications, privacy-preserving data sharing, and enhanced partner trust even in fragmented and cross-organizational logistics environments (Fernandez-Vazquez et al., 2022; Purusottama & Hasudungan, 2025; Singh & Jenamani, 2024; Dubey et al., 2024; Christodoulou et al., 2024). Blockchain's defining features decentralised and immutable record-keeping, automated data sharing, and real-time traceability are therefore frequently positioned in the literature as supportive of efforts to improve transparency and sustainability reporting, rather than as stand-alone solutions (Fang et al., 2025; Fernandez-Vazquez et al., 2022; Moatari-Kazerouni et al., 2024; Schinckus, 2020; Wu & Tran, 2018; Sharma et al., 2025).

Yet, despite its potential, empirical evidence on whether BCT can reliably and consistently enhance sustainability performance in SMEs remains limited and inconclusive, making the effectiveness of BCT in green logistics a key unresolved problem. SMEs continue to face considerable barriers, including high implementation costs, knowledge gaps, interoperability issues, and regulatory ambiguities that can undermine effective blockchain integration in logistics (Al-Rakhami & Al-Mashari, 2022; Fernandez-Vazquez et al., 2022; Chavalala et al., 2024; Jain et al., 2020; Singh et al., 2024; Behl et al., 2024). Systematic reviews and empirical studies highlight persistent challenges in standardization, reference architectures, cross-chain interoperability, and process modeling for blockchain-enabled supply chains (Al-Rakhami & Al-Mashari, 2022; Milani et al., 2021; Dubey et al., 2024; Singh et al., 2024).

Although the literature on blockchain and sustainability is rapidly expanding, important gaps persist. Most existing research emphasizes technological, economic, or internal organizational drivers and barriers to BCT adoption (Kamewor et al., 2024; Ouni & Ben Abdallah, 2024; Milani et al., 2021; Shah et al., 2023; Chavalala et al., 2024). However, much less is known about how SMEs often characterised by limited capital, smaller labour forces, and sector-specific operational vulnerabilities interpret and respond to sustainability pressures when considering process innovations involving blockchain**.** Recent studies point to the complex interplay between institutional forces and organizational adaptation, suggesting that transparent, automated, and privacy-preserving solutions can help firms balance regulatory compliance, market expectations, and resource constraints (Purusottama & Hasudungan, 2025; Singh & Jenamani, 2024; Dubey et al., 2024; Behl et al., 2024; Christodoulou et al., 2024). However, the ways in which institutional pressures are translated into changes in logistics process design and management remain underexplored in SME contexts.

To address these issues, this research draws on two complementary theoretical lenses: institutional theory and business process management (BPM). Institutional theory (DiMaggio & Powell, 1983; Scott, 2013) helps explain how organisations perceive and respond to external pressures from regulators, customers, industry bodies, and peers. In green logistics, such pressures are often understood by firms as shaping expectations regarding the adoption of blockchain and other sustainability-oriented technologies (Delmas & Toffel, 2008; Seuring & Müller, 2008; Spiga et al., 2024). BPM, by contrast, explains how firms must analyse, map, standardise, and integrate logistics workflows so that digital tools like blockchain can be embedded into routine operations and deliver sustainability gains (Dumas et al., 2013; Van der Aalst, 2013; Milani et al., 2021). It emphasizes continual improvement, process redesign, and cross-organizational integration, particularly where digital tools such as blockchain are embedded into logistics workflows (Fernandez-Vazquez et al., 2022; Singh & Jenamani, 2024). Yet despite its relevance, BPM has received limited attention in blockchain adoption research, leaving a gap in understanding how institutional pressures are operationalized into process-level changes in SMEs. Accordingly, this study investigates how external sustainability pressures are translated into blockchain-enabled

process innovation within SMEs, focusing specifically on green logistics in the UK context. This leads to the overarching research question:

How do institutional forces and process innovation interact to shape SMEs' engagement with blockchain technology for sustainable logistics in the UK?

Our paper begins by discussing BCT and sustainability, emphasising their significance for SMEs. We then present the theoretical background that underpins our study, followed by a detailed explanation of our methodological approach to data collection and analysis. After presenting and discussing our findings, we develop an integrative model that illustrates how institutional pressures and process innovation interact to shape blockchain adoption in SMEs. The paper concludes by outlining our contributions, evaluating the practical implications, and identifying avenues for further research.

## 2. Theoretical Background

### 2.1 BCT and Sustainable Logistics

Blockchain technology (BCT) has evolved well beyond its origins as the backbone of cryptocurrencies and is increasingly discussed as a general-purpose technology with potential relevance for business process innovation and sustainable logistics (Schinckus, 2020; Wu & Tran, 2018; Sharma et al., 2025; Christodoulou et al., 2024). Its decentralised, cryptographically secure infrastructure enables immutable and transparent record-keeping, peer-to-peer transactions, and automated data verification capabilities, which are commonly highlighted in the literature as addressing persistent logistics challenges such as data fragmentation, limited traceability, and complex compliance demands (Fang et al., 2025; Upadhyay et al., 2021; Jain et al., 2020). Recent studies further suggest that BCT adoption in supply chains is associated with enhanced traceability and support for ecological sustainability and circularity in sectors such as agrifood and retail, reinforcing its perceived suitability as a green transformation tool for SMEs (Happy et al., 2023; İndap & Tanyaş, 2023; Behl et al., 2024; Sharma et al., 2025; Jimenez-Castillo et al., 2024). Similarly, existing research indicates that blockchain adoption is linked to improvements in transparency, governance, and traceability across complex supply networks, including agribusiness, pharmaceuticals, and real estate (Moatari-Kazerouni et al., 2024; Purusottama & Hasudungan, 2025; Spiga et al., 2024; Singh et al., 2024).

For SMEs, these blockchain characteristics are frequently described as supporting more coordinated supply chain interactions, sustainability reporting, and participation in green markets that increasingly demand credible and timely environmental data (Nuryyev et al., 2020; Qadri et al., 2025; Varma et al., 2024; Behl et al., 2024; Jain et al., 2020). From a BPM perspective, such potential benefits align with principles emphasising standardised and auditable workflows, data integrity, and end-to-end process visibility as foundations for operational coherence and performance improvement, rather than as outcomes guaranteed by technology alone.

As logistics and transport sectors seek to reduce their environmental footprint, green logistics has emerged as a focal area encompassing strategies such as carbon emission tracking, eco-friendly route optimisation, the use of alternative fuels, and digitised vehicle tracking to enhance operational visibility (Sun et al., 2022; Kamewor et al., 2024; Chen et al., 2024; Tetteh et al., 2025; Obiri-Yeboah et al., 2025). Within this context, BCT is increasingly positioned in the literature as a potential enabler of green logistics initiatives (Sharma et al., 2025; Chavalala et al., 2024). For example, studies describe how integrating blockchain with Internet of Things (IoT) sensors and GPS technologies can support the monitoring and recording of carbon emissions per shipment or vehicle, thereby assisting firms in meeting regulatory requirements and participating in voluntary carbon markets (Almutairi et al., 2023; Saberi et al., 2019; Christodoulou et al., 2024). Case-based evidence further illustrates how blockchain-supported applications are used to automate carbon credit verification, enable eco-routing, and verify sustainable fuel sourcing, while also enhancing auditability and stakeholder trust (Moatari-Kazerouni et al., 2024; Purusottama & Hasudungan, 2025; Spiga et al., 2024; Dubey et al., 2024).

These digital applications are frequently discussed as supporting internal process improvement and strengthening transparency for regulators, customers, and supply chain partners (Singh & Jenamani, 2024; Dubey et al., 2024). From a BPM standpoint, such use cases illustrate how blockchain may function as a process coordination and data-integration mechanism, helping to synchronise information flows across organisational boundaries and potentially reduce delays, errors, and non-value-adding activities in logistics workflows subject to appropriate process design and organisational readiness.

Despite these opportunities, BCT adoption among SMEs is widely recognised as challenging due to technical, financial, and institutional barriers. High initial investment costs, limited digital skills, and uncertainty surrounding regulatory standards particularly those related to environmental impact, data privacy, and cross-border logistics are frequently cited as factors constraining adoption (Abdollahi et al., 2023; Biswas et al., 2023; Schinckus, 2020; Chavalala et al., 2024; Behl et al., 2024). The literature also highlights persistent challenges such as interoperability across blockchain platforms, the absence of reference architectures, and the paradox of blockchain's own energy consumption, especially for systems relying on energy-intensive consensus mechanisms (Al-Rakhami & Al-Mashari, 2022; Rudd et al., 2023; Yan et al., 2024; Dubey et al., 2024).

Compared with other digital technologies including artificial intelligence or the Internet of Things which are often emphasised for predictive analytics, automation, and real-time monitoring, blockchain's distinctive contribution is commonly framed as its capacity to support data integrity, auditability, and trust across distributed networks (Parmentola et al., 2022; Li et al., 2022). However, these perceived strengths are counterbalanced by scalability and energy concerns, rendering blockchain adoption more complex and resource-intensive than many other digital innovations (Zhou et al., 2020; Sedlmeir et al., 2020). As a result, understanding blockchain's sustainability relevance requires attention not only to its technical attributes but also to the

institutional contexts that shape adoption pressures and the process innovations required to operationalise its use**.**

While much of the existing literature has focused on internal readiness, technology fit, or the direct business case for blockchain in logistics (Al-Rakhami & Al-Mashari, 2022; Singh & Jenamani, 2024; Jain et al., 2020), there remains a notable gap in understanding the broader institutional environment surrounding SME adoption (Dubey et al., 2024; Chavalala et al., 2024; Behl et al., 2024). Recent studies suggest that coercive, normative, and mimetic pressures are commonly associated with blockchain adoption in sustainable supply chains, yet clearer theoretical explanation is needed to understand how these pressures are interpreted and prioritised within SME contexts (Happy et al., 2023; Jimenez-Castillo et al., 2024). In particular, limited research has examined how external pressures including regulation, industry standards, customer requirements, and competitive dynamics shape the motivations, pace, and practical processes through which SMEs engage with blockchain in green logistics initiatives (Ezzi et al., 2023; Fang et al., 2025; Nayak & Dhaigude, 2019; Spiga et al., 2024; Sharma et al., 2025). Moreover, the literature has yet to sufficiently explain how such external pressures are translated into operational and sustainability-related outcomes, an adaptation process that BPM scholars argue is fundamentally dependent on capabilities such as process mapping, workflow standardisation, and capability alignment (Milani et al., 2021; Singh & Jenamani, 2024; Sharma et al., 2025).

## 2.2 Toward a Multi-Level Analytical Framework: Bridging Institutional Forces and Business Process Innovation

### Institutional Theory

Institutional Institutional theory emerged in the late 1970s and early 1980s as a response to the limitations of purely rational and economic models of organisational behaviour (Meyer & Rowan, 1977). It was further developed by DiMaggio and Powell (1983), who introduced the concept of institutional isomorphism to explain how organisations tend to become similar in response to coercive (regulatory), normative (professional and industry standards), and mimetic (peer imitation) pressures. This perspective has since been widely applied in sustainability and logistics research to help explain why organisations adopt or consider adopting green practices or digital technologies not solely for immediate economic gain, but to align with evolving expectations from governments, customers, industry associations, and competitors (Delmas & Toffel, 2008; Hoffman, 1999; Purusottama & Hasudungan, 2025; Scott, 2013; Spiga et al., 2024). Understanding these three pressure types is therefore important for interpreting how SMEs perceive and respond to sustainability-related expectations, including those associated with BCT adoption in green logistics contexts.

## Business Process Management (BPM)

Business Process Management (BPM) emerged from the total quality management and business reengineering movements of the 1980s and 1990s (Davenport, 1993; Hammer & Champy, 1993). BPM emphasises the systematic mapping, analysis, and improvement of business processes through the integration of information technologies and management practices, with the aim of supporting efficiency, adaptability, and organisational learning (Dumas et al., 2013; Van der Aalst, 2013; Milani et al., 2021). In logistics contexts, BPM has been applied to support green transformation initiatives by enabling firms to redesign routing processes, digitise shipment tracking, monitor emissions, and pursue continuous improvement in both economic and environmental dimensions (Milani et al., 2021; Seuring & Müller, 2008; Upadhyay et al., 2021).

Recent literature also emphasises the relevance of BPM for supporting cross-organisational process integration, which is particularly salient when deploying blockchain in logistics networks where data, responsibilities, and decision-making are distributed across multiple actors (Fernandez-Vazquez et al., 2022; Singh & Jenamani, 2024). From this perspective, BPM can be understood as a set of organisational capabilities that help firms translate external expectations into structured process changes, rather than as a deterministic mechanism that guarantees sustainability outcomes.

## Integrating Institutional Theory and BPM

Institutional theory and BPM offer a complementary framework for analysing blockchain adoption in green logistics. Institutional theory provides insight into why organisations may feel compelled or encouraged to engage with sustainability-oriented digital innovations in response to external pressures, while BPM offers an operational lens for examining how such innovations are interpreted, implemented, and embedded within organisational processes.

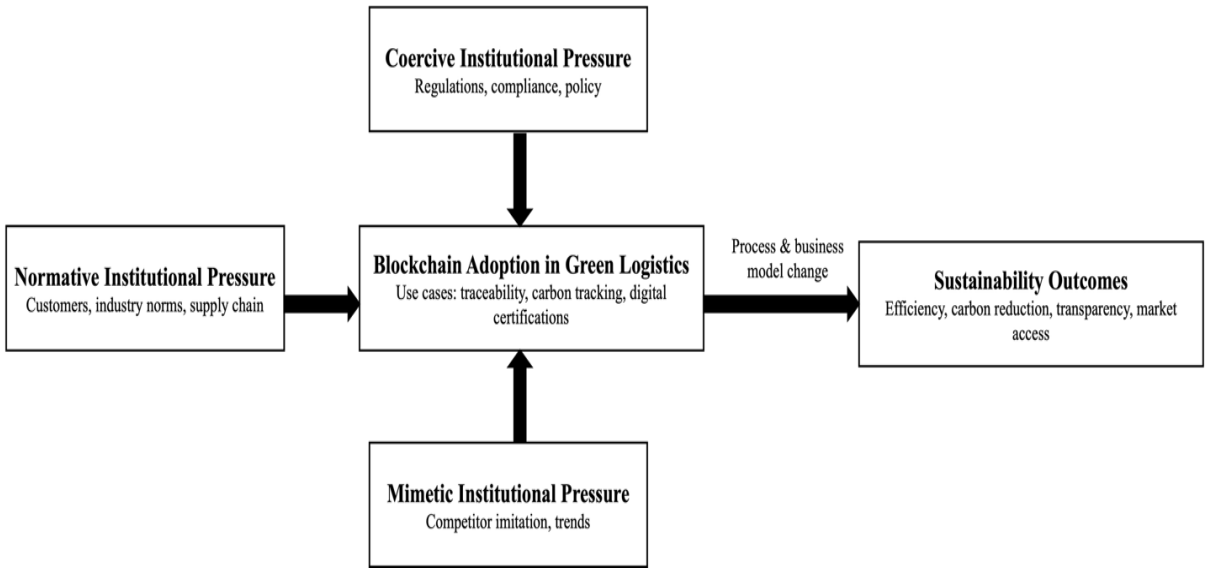
This integrated perspective highlights a theoretically important connection: while institutional forces may prompt interest in or consideration of BCT adoption, the extent to which such adoption contributes to sustainability objectives appears to depend on how firms adapt, redesign, and manage their logistics processes. Rather than assuming direct causal pathways, this framework emphasises the contingent and context-dependent nature of blockchain-enabled sustainability initiatives, particularly within resource-constrained SME settings.

Accordingly, this study adopts a multi-level analytical framework that brings together institutional theory and BPM as interpretive lenses. The framework is used to explore how coercive, normative, and mimetic pressures are understood by SMEs, how these pressures relate to blockchain-related

decisions, and how internal process capabilities shape the ways in which blockchain is integrated into green logistics practices.

Figure 1 presents an exploratory and interpretive conceptual framework illustrating how coercive, normative, and mimetic institutional pressures are associated with SMEs' engagement with blockchain technology in green logistics. It serves as a theory-building device that highlights how external institutional pressures are perceived and interpreted by SMEs, and how BPM capabilities including process mapping, redesign, and capability alignment provide the organisational context through which blockchain-related sustainability practices are selectively enacted.

Figure I. Conceptual framework linking institutional pressures, blockchain adoption in green logistics, and sustainability outcomes.




**Methodology and Data collection**

This study adopted a qualitative exploratory research design, using semi-structured interviews to explore how environmental institutional pressures shape the adoption of BCT for sustainability within SMEs. Given the complexity of the subject and the need for rich, context-sensitive insight, an exploratory qualitative approach is particularly well suited to capture the nuanced reasoning, trade-offs, and decision-making dynamics that would likely be inaccessible through quantitative surveys (Creswell & Poth, 2016; Merriam, 2015). To capture both breadth and depth, the study employed a dual-informant strategy. Rather than relying solely on single-firm perspectives, it combined insights from two complementary respondent groups: SME consultants and SME

directors. Consultants were selected because of their extensive experience advising multiple SMEs on sustainability strategies and digital transformation, including BCT. Their position enabled them to synthesize cross-sectoral patterns, highlight common barriers and drivers, and provide a wider and more objective view of how institutional pressures shape adoption (Yin, 2018; Guest, Namey, & Mitchell, 2013). To complement this perspective, SME directors were also included to provide direct accounts of firm-level decision-making, internal resource constraints, and organizational trade-offs that may not always be visible to external advisors. This triangulation helped mitigate single-source bias and enriched the analysis by balancing comparative breadth with situated practice.

A purposive sampling strategy was used to recruit 12 SME consultants and 6 SME directors based in the UK. All consultants had at least five years of professional experience supporting SMEs in sustainability and digital technology adoption, and were drawn from sectors including manufacturing, logistics, services, agriculture, and technology to ensure diverse representation. These industry groups were prioritised because they represent major contributors to carbon emissions and logistics-related activities within the UK SME economy, making them highly relevant for understanding blockchain-enabled green logistics applications. Including a mix of high-logistics-dependency sectors (e.g., transport, retail) and sustainability-critical sectors (e.g., food, waste) enhanced the applicability of findings across varied operational contexts. Recruitment took place through professional associations, LinkedIn, industry events, and referrals, focusing on those with demonstrable experience in advising SMEs on green logistics initiatives, carbon reduction, and digital transformation projects (see Table 1). In parallel, six SME directors were recruited to reflect sectoral variation and different stages of BCT adoption. Both small and medium-sized firms were included to capture the different resource constraints and adoption pressures that influence BCT implementation decisions, improving transparency and reproducibility in sampling logic. This purposive selection ensured coverage of both logistics-intensive and sustainability-relevant industries, while also spanning different adoption stages. Recruitment was facilitated through professional associations, sustainability networks, and referrals. The sample of 18 participants (12 consultants and 6 directors) was determined using purposive logic and the principle of data saturation, meaning interviews continued until no substantially new themes or insights were emerging (Guest, Namey, & Mitchell, 2013; Saunders & Townsend, 2016). This sample size aligns with established qualitative research practice, particularly when participants are highly knowledgeable and provide rich perspectives across diverse contexts (Guest et al., 2013; Creswell & Poth, 2016).

## Table I. Profile of Respondents

| Respondent Code | Industry Focus | UK SIC Code(s) | Years Experience | Consultancy Role | Blockchain/Green Logistics Expertise |
|---|---|---|---|---|---|
| C1 | Manufacturing & Supply Chain | 10–33 | 12 | Senior Consultant | Blockchain implementation, carbon audit design |
| C2 | Logistics/Transport | 49–53 | 15 | Director | Green logistics, blockchain in fleet management |
| C3 | Technology | 61–63 | 9 | Digital Transformation Lead | SME blockchain adoption, digital strategy |
| C4 | Agriculture/Food | 01–03, 10–12 | 7 | Sustainability Consultant | Sustainable sourcing, blockchain traceability |
| C5 | Professional Services | 69–75 | 8 | Partner | ESG compliance, carbon accounting with blockchain |
| C6 | Logistics | 49–53 | 10 | Operations Consultant | Route optimization, vehicle tracking |
| C7 | Energy & Utilities | 35, 36–39 | 11 | Sector Specialist | Blockchain for energy sourcing, emission tracking |
| C8 | Technology/SMEs | 61–63 | 14 | Digital Innovation Advisor | SME process reengineering, DLT pilots |
| C9 | Retail & Distribution | 47 | 6 | Green Supply Chain Advisor | Blockchain for product origin verification |
| C10 | Manufacturing/Logistics | 10–33, 49–53 | 10 | Director, SME Practice | Process redesign, compliance, digital adoption |
| C11 | Food & Beverage | 10–12 | 8 | Senior Consultant | Carbon credits, sustainable logistics |
| C12 | Transport & Infrastructure | 49–52 | 13 | Principal Consultant | Policy, standards, blockchain for emissions |
| D1 | Food | 10–12 | 10 | Director (Small SME) | Pilot blockchain for traceability in food supply |
| D2 | E-commerce Retail | 47 | 8 | Director (Small SME) | Exploring blockchain for parcel flows and returns |

| | | | | | |
|---|---|---|---|---|---|
| D3 | Manufacturing | 10–33 | 12 | Director (Small SME) | Warehouse management system with blockchain-based data-sharing pilot |
| D4 | Construction | 41–43 | 15 | Director (Medium SME) | Product passport initiatives; blockchain for materials traceability |
| D5 | Waste & Recycling | 38 | 9 | Director (Small SME) | Blockchain for chain-of-custody and compliance reporting |
| D6 | Agrifood | 01–03 | 11 | Director (Small SME) | Certification traceability with blockchain pilots |

Note: The Respondent Code refers to the unique identifier allocated to each interviewee to maintain anonymity while allowing reference throughout the analysis.

All respondents held advanced degrees and/or professional certifications in sustainability, business process management, or digital transformation, or had extensive managerial experience in SME operations. This dual-informant design allowed consultants to provide comparative, cross-sectoral insights, while directors contributed grounded, firm-level accounts of decision-making. Together, these perspectives offered a robust foundation for analyzing how institutional pressures and internal processes jointly shape BCT adoption in green logistics.

## Data Collection

Data was collected through semi-structured interviews, guided by a protocol informed by institutional theory and BPM (Appendix A). The interview guide was designed to accommodate both SME consultants and SME directors, with parallel wording to ensure comparability across groups. Core topics included perceptions of environmental and regulatory pressures affecting SMEs; how blockchain and related digital tools are evaluated and implemented for green logistics; barriers, challenges, and sector-specific factors influencing adoption; concrete examples of organizational responses to institutional and industry demands; and reflections on competitor and supply chain influence, as well as sectoral variation.

To ensure methodological rigor, we applied established credibility and trustworthiness strategies appropriate for interpretive research, rather than statistical validation procedures more suited to quantitative designs. First, the interview guide was reviewed by two experts, one academic and one practitioner, both specialising in digital transformation and sustainability within SMEs. A pilot interview was then conducted to refine question wording, sequencing, and contextual relevance, ensuring that the protocol elicited rich insights aligned with the research objectives. Second,

triangulation strengthened the robustness of findings by incorporating two distinct yet complementary respondent groups, SME consultants and SME directors, allowing cross-verification of themes emerging from different stakeholder perspectives. Third, the research team maintained a transparent coding audit trail throughout thematic analysis, documenting coding decisions, theme development, and analytical memos to ensure traceability and methodological transparency. Fourth, to enhance dependability and reduce individual researcher bias, collaborative coding sessions were conducted involving multiple coders who independently coded selected transcripts and compared interpretations. Coding discrepancies were discussed and resolved through consensus-building, providing an internal check on analytic consistency. Finally, reflexive practices were integrated across the research process, including researcher positionality statements and ongoing reflections regarding potential assumptions and influence on data interpretation. Collectively, these measures reinforce the credibility, dependability, and confirmability of the findings and support the scientific validity of the qualitative evidence presented.

Interviews were conducted online via Microsoft Teams between January 2024 and October 2024, each lasting 45–60 minutes. Prior to data collection, ethical approval was obtained. All interviews were audio-recorded with informed consent, then transcribed verbatim and anonymized (Guest, Namey, & Mitchell, 2013; Saunders & Townsend, 2016). In addition to primary interviews, the study also drew on secondary materials provided by respondents, including internal consultancy reports, case documentation, industry publications, company websites, and reference materials. This triangulation enriched the analysis, validated emerging themes, and provided contextual depth for both consultant and director perspectives.

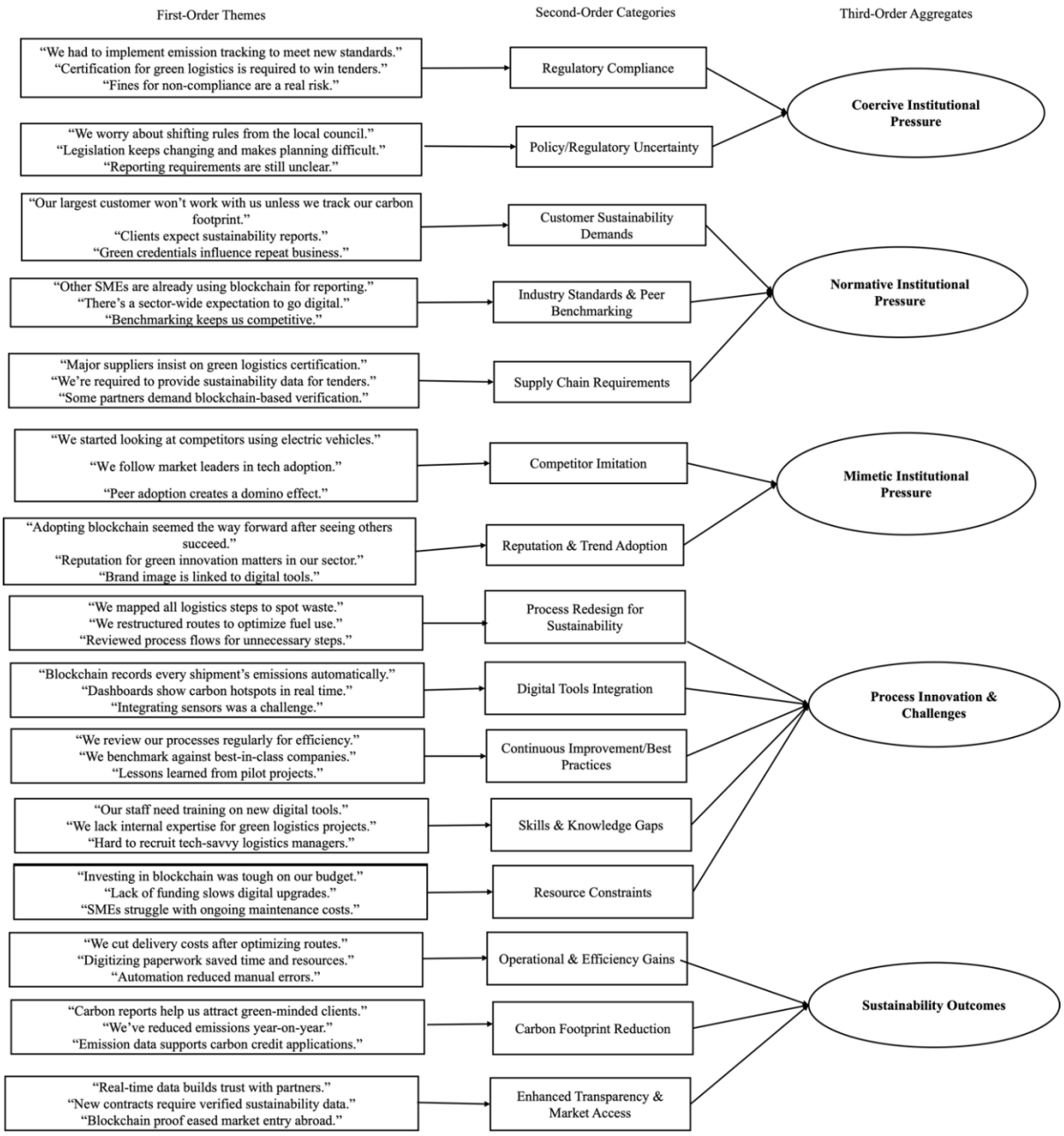
**Data Analysis**

Data analysis followed the six-phase thematic analysis approach outlined by Braun and Clarke (2006), ensuring a systematic yet flexible method suitable for exploratory qualitative research. The process began with repeated readings of interview transcripts to support familiarisation and early identification of recurring ideas. Coding combined inductive (data-driven) insights with deductive guidance informed by institutional theory and BPM concepts to ensure analytical alignment with the study's objectives. NVivo 14 software was used to organise and manage the coded data, maintaining transparency and traceability throughout the process (Edwards-Jones, 2014). Initial descriptive codes were generated to capture significant phrases, examples, and perceptions related to blockchain adoption and sustainability in logistics. These initial codes were progressively refined and grouped into conceptually meaningful categories through an iterative process of comparison across transcripts, particularly between consultants and SME directors.

The development of themes was guided by existing theoretical constructs related to coercive, normative, and mimetic institutional pressures**,** while additional themes emerged inductively, such as process innovation challenges and perceived sustainability outcomes**.** Themes were continually reviewed against the dataset to ensure they reflected both common and divergent perspectives,

supporting depth and analytical credibility. To enhance transparency and indicate the relative salience of issues, light quantification was applied by noting the number of interviewees who referenced each coded issue. For example, regulatory uncertainty was mentioned by a majority of consultants, while directors more frequently emphasised sector-specific operational burdens. This quantification complemented rather than replaced interpretive analysis, consistent with recommendations to enrich qualitative thematic findings with frequency indicators. This step-by-step analytic process allowed the identification of five interrelated themes that collectively explain how blockchain adoption in SMEs is shaped and constrained in the context of green logistics: coercive, normative, and mimetic pressures; process innovation challenges; and sustainability outcomes (Figure 2). While the dual-informant design enhances triangulation and thematic robustness, limitations remain due to the small director sample concentrated in specific sectors. These perspectives are therefore considered illustrative rather than representative of all SMEs, highlighting the need for future comparative research involving larger and more diverse organisational contexts.

Figure II. Data Structure



## 4. Findings

*1. Coercive Institutional Pressure*

Both consultants and SME directors consistently described regulatory compliance as a prominent influence on green logistics practices and as a persistent source of operational tension. Consultants frequently characterised SMEs' responses to regulation as reactive, often using the term "compliance chasers." As one consultant (C2) explained, *"We had no intention of investing in emission tracking, but new government standards left us no choice if we wanted to stay in certain supply chains."* Another consultant (C10) highlighted the instability associated with regulatory change: *"The legislation is a moving target; our clients ask, 'How do we future-proof our processes when every year brings a new set of requirements?'"*

Directors provided firm-level examples that reinforced these concerns. One director (D4) noted, *"Certification rules for sustainable materials keep shifting; last year we invested in one reporting system, only to find it no longer met the criteria for a government tender."* For smaller firms, the implications were often described as immediate and operationally disruptive. As D1 explained, *"Supermarkets now demand verified carbon reporting. Without it, we risk losing contracts, regardless of how well we manage costs elsewhere."* Similarly, D6 highlighted the strain on limited staff resources: *"We had to divert people from production just to keep up with the new traceability paperwork; it slowed down day-to-day operations."*

Across both respondent groups, uncertainty surrounding policy interpretation was frequently mentioned. Consultants described ambiguity in regulatory guidance, with one (C4) stating, *"We often worry, are we building something that will still meet the standards next year?"* SMEs at earlier stages of blockchain experimentation described how limited financial and human resources intensified these uncertainties.

Secondary materials shared by respondents, including regulatory updates and policy documents, reflected these perceptions of frequent change. Emission reporting standards, carbon audit requirements, and certification schemes have undergone repeated revisions since 2022. Industry sources (Logistics UK, 2023; CILT, 2022; BEIS, 2021; DEFRA, 2018; DEFRA, 2023; ONS, 2023) document ongoing updates and penalties associated with non-compliance.

Respondents also described variation in how regulatory requirements were experienced across firms. Directors from higher-turnover or better-capitalised SMEs (e.g., D4) reported greater ability to invest in compliance systems or external expertise. In contrast, directors from smaller firms with tighter margins (e.g., D1 and D6) described reallocating staff time away from core operations to meet documentation and reporting demands. Workforce size further shaped responses, with

smaller SMEs often lacking personnel dedicated to monitoring regulatory developments. Sectoral differences were also evident, as respondents from logistics-intensive industries such as food distribution and waste management reported more frequent monitoring and documentation requirements than those in service-oriented sectors.

Although blockchain was frequently mentioned by respondents as a tool used for traceability, emissions reporting, or certification purposes, directors also described practical challenges associated with its use. As one director (D5) noted, *"Blockchain helps us prove compliance, but the subscription fees and training costs eat into margins; we don't always see the payoff."* These accounts reflect the varied experiences of SMEs engaging with blockchain in response to regulatory demands. References to regulatory compliance appeared in nearly all consultant interviews (11 of 12) and in four of the six director interviews. Concerns about shifting certification requirements were particularly prominent among respondents from construction and agrifood sectors.

*2. Normative Institutional Pressure*

Normative forces arising from customer expectations, industry benchmarks, and supply chain partner requirements were consistently mentioned by both consultants and SME directors. Participants described these pressures as shaping expectations around sustainability-related practices, particularly in relation to data provision, traceability, and emissions reporting. Consultants frequently emphasised the role of customers and buyers in setting these expectations. As one consultant (C1) stated, *"It's the customers driving a lot of this change. Our clients get asked, 'Can you prove your deliveries are green?' and if they say no, the contracts go elsewhere."* Internal consultancy documents shared by respondents (C3, C8) similarly indicated that sustainability clauses and environmental data requirements had become common features of supplier contracts, especially when SMEs were working with larger corporate buyers.

Directors provided firm-level examples of how these expectations were encountered in practice. One director (D1) explained, *"One of our supermarket customers now demands quarterly carbon reports; if we don't provide them, they'll go to another supplier. For us, that's a contract worth half our turnover."* Another director (D2) described similar experiences: *"Customers expect tracking and emissions data at checkout; it's no longer optional. The platforms we sell through won't list you if you can't provide it."* D4 noted that partner expectations also extended beyond formal compliance requirements: *"We're increasingly asked about digital product passports; it's not regulation yet, but if competitors can provide them, we'll be dropped from tenders if we can't."*

Across interviews, respondents described a shared perception that sustainability-related data provision was becoming a standard expectation within many sectors. Consultants referred to the influence of industry associations, buyer platforms, and best-practice publications in reinforcing these expectations. As one consultant (C7) put it, *"We're seeing suppliers say, 'No data, no deal.'*

*That's new, and it's a big shift."* Several participants also referred to reputational concerns. One consultant (C9) observed, *"There's this sector-wide anxiety, SMEs don't want to be the last ones to go digital or to be seen as laggards."* Directors echoed these sentiments. As D5 noted, *"We worry more about looking outdated than about fines. If a competitor can prove chain-of-custody digitally, we'll lose credibility with our clients."*

Participants also reported variation in how these expectations were experienced across firms. Directors from SMEs with greater capital and larger employee bases (e.g., D4) described more scope to invest in systems to meet customer requirements. In contrast, directors from smaller firms with tighter margins (e.g., D1 and D2) reported difficulties balancing customer demands with financial constraints. Sectoral exposure was also mentioned, with respondents from logistics-intensive and consumer-facing sectors describing stronger expectations than those operating in service-oriented activities.

Blockchain was frequently mentioned as one tool used by SMEs in response to customer and partner requirements, particularly for traceability, emissions reporting, and digital certification. However, respondents described mixed experiences. While some directors viewed blockchain adoption as supporting customer relationships, others highlighted cost and integration challenges. As D2 explained, *"Integrating blockchain made us look good to customers, but the system cost more than the margin we make on most orders."*

Customer-driven expectations were referenced in nine of the twelve consultant interviews and five of the six director interviews. Supply chain partner requirements were most frequently mentioned in manufacturing, food, and construction SMEs. Directors of smaller firms consistently described these expectations as placing disproportionate strain on organisations with limited turnover and staffing.

*3. Mimetic Institutional Pressure*

Imitative behaviour associated with competitor actions and sector leadership was frequently mentioned by both consultants and SME directors. Consultants described SMEs as closely observing the initiatives of competitors and larger market actors. As one consultant (C12) explained, *"Everyone is watching what the market leaders are doing; if a big player pilots blockchain or starts electrifying their fleet, the rest scramble to follow."* Another consultant (C8) recounted common client concerns: *"Our competitor just announced their new sustainability dashboard what are we doing about ours?"* Secondary materials cited by respondents, including market reports and industry news, similarly referenced competitor initiatives when discussing blockchain pilots or sustainability investments (Logistics UK, 2023; KPMG, 2023; Financial Times, 2021; CBRE, 2023).

Directors confirmed that competitor actions were a salient reference point, particularly in visible and consumer-facing sectors. One director (D2) stated, *"When our competitors started advertising carbon-neutral delivery, we had to explore similar options; we couldn't risk looking behind the curve."* Another director (D3) described a comparable experience: *"We joined a blockchain pilot mainly because a competitor in our niche did. We didn't want customers asking, 'Why aren't you doing this?'"* In contrast, some directors described a more cautious approach. As D4 explained, *"We monitor what others are doing with digital passports, but we only adopt once we're confident it will deliver long-term value."*

Several consultants cautioned that imitation was often associated with urgency rather than detailed evaluation. One consultant (C3) noted, *"Sometimes it's not about direct business need, but about being able to say, 'We're innovative too.'"* Directors provided similar accounts. As D5 reflected, *"We copied a digital reporting tool because competitors were talking about it, but it ended up being more admin than benefit."* These experiences were described by one consultant (C6) as examples of "shiny tech for tech's sake."

Participants reported variation in how SMEs responded to competitor activity. Directors from better-capitalised firms (e.g., D4) described greater capacity to observe, test, and selectively adopt practices. Directors from smaller SMEs (e.g., D2 and D3) more frequently described adopting technologies quickly, often with limited internal evaluation. Workforce capacity was also mentioned as influencing responses, with medium-sized firms reporting more ability to allocate staff to pilot assessment.

Blockchain was commonly referenced in relation to competitor-driven adoption. Some directors described reputational benefits, such as improved tender credibility. As D3 noted, *"Being part of the blockchain pilot made us look credible in tenders."* Others highlighted limited utilisation and uncertain returns. As D2 explained, *"We signed up to show customers we were modern, but we've barely used the system."*

References to competitor-driven imitation appeared in eight of the twelve consultant interviews and in four of the six director interviews. Concerns about superficial or symbolic adoption were raised in eight consultant interviews and three director cases. Respondents from e-commerce, manufacturing, and waste and recycling sectors most frequently discussed mimetic pressures.

### *4. Process Innovation and Challenges for Green Logistics*

Transforming logistics processes for sustainability was consistently described by respondents as challenging, resource-intensive, and dependent on internal organisational capacity. Consultants frequently identified process mapping as a common starting point when working with SMEs. As one consultant (C1) explained, *"We start every engagement by mapping logistics processes end-*

*to-end; it's shocking how much waste is invisible until you lay it all out."* Several consultants referred to the use of digital mapping and benchmarking tools (Department for Transport, 2023) to visualise inefficiencies and emissions hotspots (C6, C10). Another consultant (C2) observed, *"Route optimisation sounds easy, but it takes weeks of data collection, new software, and a willingness to change established routines."*

Directors provided firm-level accounts illustrating how these challenges were experienced in practice. One director (D1) stated, *"We know our routes aren't efficient, but we don't have staff to monitor them daily; every driver already does multiple jobs."* Another director (D2) echoed this resource strain: *"We'd love to trial more digital tools, but our sales turnover doesn't support constant software subscriptions."* Directors from larger SMEs described different constraints. As a construction SME director (D4) noted, *"We have the capital to test digital product passports, but retraining staff across multiple sites is still a major challenge."* Across interviews, respondents described variation in how logistics process innovation was approached, depending on available resources, workforce size, and sectoral context.

Integrating blockchain and other digital tools was discussed as presenting both opportunities and difficulties. Consultants highlighted potential benefits, such as automated emissions recording *"Blockchain records every shipment's emissions automatically"* (C3) while directors emphasised practical barriers to implementation. One director (D5) remarked, *"We piloted blockchain for chain-of-custody, but without IT staff it just created extra admin."* Another director (D3) explained, *"We joined a blockchain data-sharing pilot, but it stalled because none of our employees had time to manage the system."* These accounts indicate that digital adoption was not universally perceived as beneficial and that several pilots were described as producing limited operational impact.

Skills and knowledge gaps were widely reported. Consultants frequently referred to a mismatch between digital ambitions and available expertise. As one consultant (C11) stated, *"Everyone wants a fancy carbon dashboard, but who's going to run it when there's no in-house data analyst?"* Directors confirmed similar experiences. As D6 explained, *"We're expected to generate certification data, but we don't have anyone trained in data management; it falls to me or my production manager."* Secondary materials shared by respondents, including case reports and implementation roadmaps, suggested that many SMEs focused on incremental adjustments rather than comprehensive process redesign. As one consultant (C4) summarised, *"Process innovation is essential, but for SMEs, it's often survival, not strategy."* Directors echoed this pragmatism. As D1 stated, *"We innovate just enough to keep contracts; long-term planning comes second."*

Respondents also described differences in experiences across sectors. SMEs operating in logistics-intensive activities such as food distribution reported ongoing pressure to optimise routing and emissions tracking, while firms in other sectors emphasised documentation and reporting-related tasks. Blockchain and other digital tools were frequently discussed in this context. While some

respondents described operational or reputational benefits, others highlighted administrative burden, underuse, or stalled implementation.

To enhance transparency, theme prevalence was tracked across interviews. Process mapping and route optimisation challenges were mentioned in nine of the twelve consultant interviews and in four of the six director interviews. Skills and staffing constraints were raised by eleven consultants and five directors. Blockchain integration was referenced in eight consultant interviews and three director interviews, reflecting its prominence in discussions while also indicating variation in perceived usefulness across SMEs.

*5. Sustainability Outcomes*

Despite persistent challenges, both consultants and directors described a range of sustainability-related outcomes associated with process innovation and digital adoption. Consultants cited multiple cases in which SMEs reported reductions in costs and emissions following relatively modest operational changes. As one consultant (C2) explained, *"Just by optimizing delivery routes, one client cut vehicle idle times by 15%; it wasn't rocket science, but it made a measurable difference."* Several respondents supported such claims with before-and-after operational data or benchmarking materials shared as secondary evidence (C2, C10). Consultants also referred to reputational outcomes. As one consultant noted, *"Green credentials are now a marketing tool; clients have won new business because they can show verified emissions reductions"* (C12).

Directors confirmed the presence of such outcomes but consistently described them in relation to firm-level constraints. One director (D1) stated, *"We secured a new supermarket contract after proving our traceability system, but it took months of paperwork and drained our small admin team."* Another director (D2) described cost-related trade-offs: *"We added carbon reporting at checkout to meet customer expectations; it helped sales, but the subscription fees eat into already thin margins."* Directors from larger SMEs described different experiences. As D4 explained, *"Digital product passports give us an edge in tenders we can demonstrate compliance and sustainability in one go."* Across interviews, respondents described variation in how sustainability-related outcomes were realised and maintained.

Blockchain-enabled traceability was frequently discussed as particularly valuable in certain contexts. Consultants referred to cases in which SMEs accessed green procurement programmes or carbon credit schemes by providing verifiable chain-of-custody or emissions data (C5, C8). One director (D5) illustrated this experience: *"Blockchain allowed us to prove chain-of-custody, which helped us win a council contract we'd never have qualified for otherwise."* At the same time, several directors emphasised ongoing cost and maintenance challenges. As D6 cautioned, *"The blockchain system looks great in audits, but the ongoing costs are unsustainable for a firm our size; we may have to drop it."*

Across interviews, respondents also raised questions regarding the balance between sustainability reporting and environmental impact. Consultants and directors alike questioned whether digital tools consistently delivered environmental benefits or primarily supported reporting and compliance activities. As one consultant (C7) noted, *"Clients ask, 'Does blockchain really make us greener, or are we just shifting the footprint somewhere else?'"* A director (D3) expressed a similar concern: *"The dashboard makes us look green, but the system itself is energy-hungry; it feels like one step forward, half a step back."* Consultants further noted that sustainability-related digital tools sometimes increased administrative workload. As C9 stated, *"There's a danger that the tools we use to report on sustainability end up adding complexity and cost, with only marginal benefit."* To enhance transparency, theme prevalence was tracked across respondents. References to verified cost or emissions savings appeared in nine of the twelve consultant interviews and in five of the six director interviews. Blockchain-enabled traceability benefits were mentioned in seven consultant interviews and three director cases. Concerns relating to sustainability trade-offs and reporting burden were raised in eight consultant interviews and four director interviews. These frequencies indicate that sustainability-related outcomes were widely discussed, while experiences varied across firms and contexts.

**Table** II**. Frequency of Theme Mentions Across Respondent Groups**

| Theme | Consultants Mentioning (n=12) | Directors Mentioning (n=6) | Total Mentions | Relative Influence |
|---|---|---|---|---|
| Coercive pressures (regulation, certification, compliance) | 11 | 4 | 15 | Very strong |
| Normative pressures (customer and supply chain expectations) | 9 | 5 | 14 | Strong |
| Mimetic pressures (competitor imitation) | 8 | 4 | 12 | Moderate–strong |
| Process innovation challenges (skills, data integration, resource constraints) | 11 | 5 | 16 | Very strong |
| Sustainability outcomes (cost and emission reductions, reputation gains) | 9 | 5 | 14 | Strong |

Table II summarises the salience of the key themes identified across the interviews by indicating how frequently each theme was mentioned by consultants and SME directors. The frequency

counts are used as an indicative measure of thematic prominence. The table shows that coercive regulatory pressures and process innovation challenges were among the most frequently discussed themes across both respondent groups, suggesting that compliance obligations and internal resource constraints were widely perceived as central considerations in relation to blockchain adoption in green logistics. Normative pressures related to customer and supply chain expectations, as well as mimetic pressures linked to competitor behaviour, were also commonly referenced. However, their perceived relevance varied across respondents, sectors, and organisational contexts, reinforcing the context-dependent nature of institutional influences in SMEs.

**Table** III**. Relative Strength of Institutional Pressures by SME Condition**

| SME Characteristic | Coercive | Normative | Mimetic | Key Insight |
|---|---|---|---|---|
| Capital Base (higher) | ▲ Strong | ▲ Strong | ▲ Strong | Larger firms adopt proactively across all pressures |
| Capital Base (lower) | ▲▲ Very High | ▲ Medium | ▼ Low–Medium | Smaller firms experience coercive pressure as dominant and more burdensome |
| Workforce Size | ▲▲ Higher staff → more ability to adapt | ▲ Moderate | ▲ Moderate | Medium SMEs can assign compliance roles and pilot digital tools |
| Sector Activity (logistics-intensive: food, waste, construction) | ▲▲ Very High | ▲▲ Very High | ▲ Moderate | Operational exposure amplifies external pressures |
| Technology Adoption Stage (early adopters) | ▲ High | ▲ High | ▲▲ Very High | Mimetic pressures strongest where competitors already piloting blockchain |
| Consumer-facing sectors | ▲ Medium | ▲▲ Very High | ▲ High | Market legitimacy dominates decisions |
| Service-oriented activity | ▼ Lower | ▲ Medium | ▲ Moderate | Less exposed to direct emissions scrutiny |

▲ *Higher strength*: stronger influence on blockchain adoption

▼*Lower strength*: weaker influence

▲▲ Indicates strongest influence within group

Table III provides a comparative overview of how respondents described the relative salience of coercive, normative, and mimetic pressures across SMEs with differing characteristics. The table synthesises recurring patterns observed in the qualitative data. Respondents from SMEs with stronger financial and human resource bases more frequently described having greater scope to respond proactively to all three types of pressure, including experimenting with digital tools and process redesign. In contrast, smaller and more resource-constrained SMEs more often reported experiencing coercive regulatory requirements as particularly burdensome and described limited capacity to respond to normative or mimetic pressures beyond basic compliance. Logistics-intensive and consumer-facing sectors were commonly portrayed as being subject to heightened external scrutiny, especially in relation to traceability, emissions reporting, and sustainability data transparency.

Tables II and III support an interpretive understanding of how institutional pressures are experienced unevenly across SMEs and how organisational conditions shape the ways in which these pressures are discussed, prioritised, and acted upon. These findings highlight variation in perceived influence, consistent with the exploratory qualitative design of the study.

Figure 2 integrates the findings from the thematic analysis**,** illustrating how distinct but interrelated institutional pressures coercive, normative, and mimetic are perceived to shape the conditions under which SMEs engage in process innovation for green logistics**.** Each pressure type was described by respondents as operating differently: coercive pressures from regulations and certification schemes were commonly associated with mandatory compliance; normative pressures arising from customer expectations, industry standards, and supply-chain requirements were linked to perceptions of legitimacy; while mimetic pressures were associated with competitive comparison and reputational signalling.

These external pressures were consistently described as being filtered through SME-specific conditions**,** including business capital, turnover, workforce size, sector activity, and adoption stage. Respondents indicated that such characteristics influenced how pressures were interpreted and managed**,** shaping whether firms pursued more proactive and strategic responses or relied on reactive and incremental adjustments.

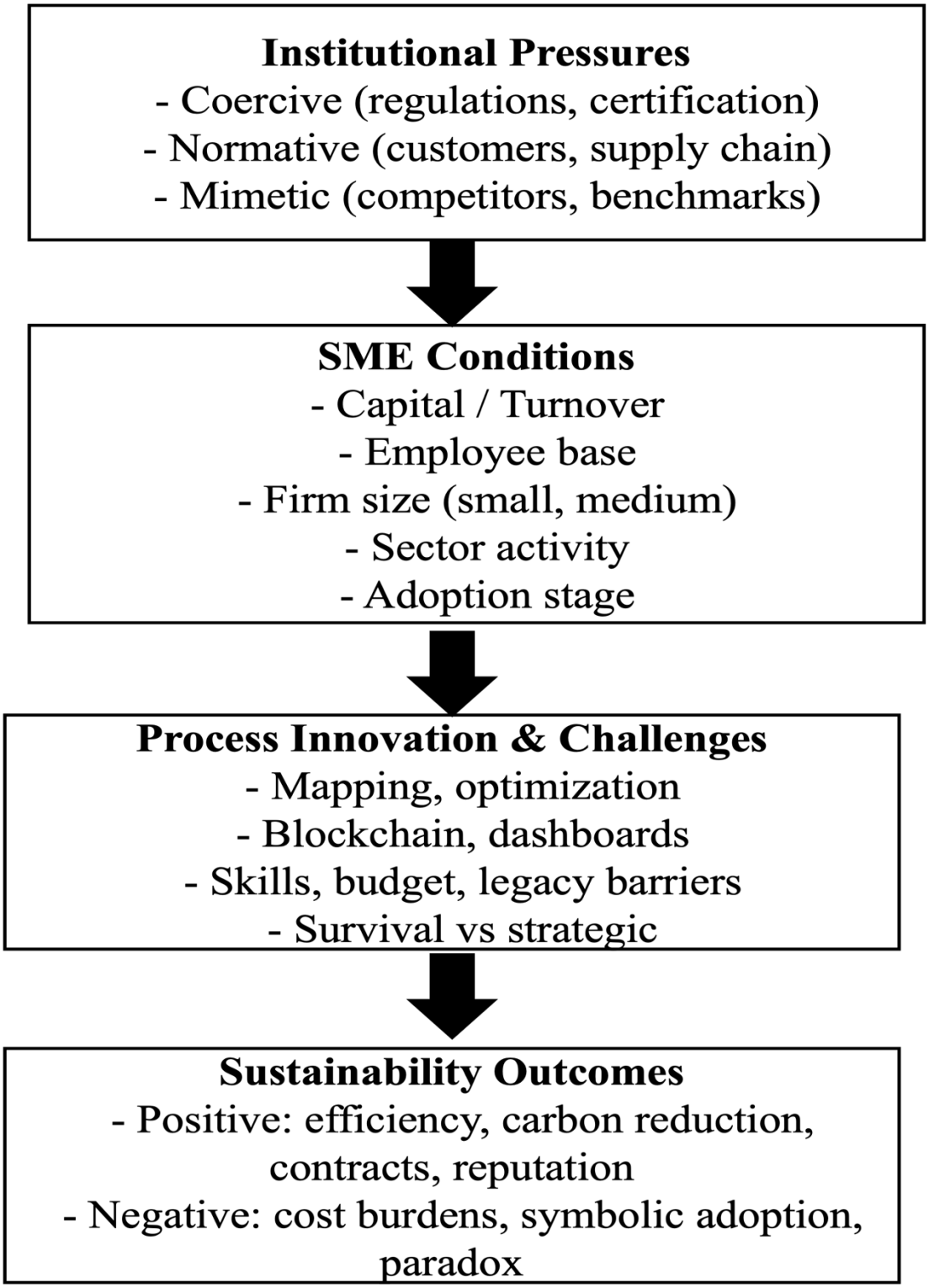
Process innovation and its associated challenges were frequently described as the mechanisms through which SMEs attempted to respond to institutional pressures. Participants referred to logistics process mapping, route optimisation, digital reporting, and data-sharing initiatives, while also highlighting persistent barriers such as limited resources, skills gaps, and system integration challenges. As a result, smaller SMEs often described incremental or survival-oriented

adjustments, whereas better-resourced firms reported greater ability to experiment with more strategic process changes.

Within this framework, BCT was positioned by respondents as a potential enabler of compliance, transparency, and trust. Its immutable record-keeping, traceability, and reporting capabilities were described as supporting responses to coercive requirements, normative expectations, and mimetic pressures. However, blockchain adoption was not uniformly perceived as beneficial. For resource-constrained SMEs, respondents noted that BCT could become burdensome if not aligned with business models or supported by adequate internal capabilities.

Finally, the interplay between institutional pressures, SME conditions, and process innovation capacity was described as shaping the sustainability-related outcomes reported by participants**.** Outcomes such as cost savings, emissions reductions, reputational benefits, and access to green procurement opportunities were more frequently reported by SMEs with stronger capital and workforce capacity, while smaller firms often described outcomes as fragile, costly, or contingent on specific customers or contracts. The model clarifies how institutional environments are interpreted by SMEs, highlights the facilitating role of organisational conditions, and positions blockchain as both an opportunity and a constraint within adaptive and exploratory sustainability transformation.

Figure III. Interrelationships among Institutional Pressures, SME Conditions, Process Innovation, and Sustainability Outcomes in Green Logistics



The findings indicate that coercive regulatory pressures were most consistently emphasised by participants when discussing BCT adoption in green logistics, largely due to their association with compliance and market access. Normative pressures from customers and supply-chain partners were also widely discussed, particularly in logistics-intensive and consumer-facing sectors where sustainability data has become increasingly expected. Mimetic pressures were present but more variable, often linked to competitive signalling rather than immediate operational necessity. Importantly, participants consistently emphasised that the perceived salience of each pressure varied according to SME characteristics, including capital base, workforce size, and sector context, shaping whether firms described proactive process innovation or reactive compliance-oriented responses.

## 5. Discussion

*A. Theory Development, Reflection on Literature, and Identification of Gaps*

This study advances institutional theory and BPM perspectives by offering an exploratory, interpretive account of how coercive, normative, and mimetic pressures are experienced by SMEs alongside firm-specific conditions in the context of blockchain adoption and process innovation for green logistics**.** Rather than reaffirming institutional drivers as universal mechanisms, the contribution lies in examining how these pressures are perceived, prioritised, and negotiated under varying resource constraints, firm sizes, sectoral contexts, and adoption stages**.** The findings suggest that the salience of coercive, normative, and mimetic pressures varies across SMEs**,** suggesting that their relative influence is neither uniform nor static**.** This observation highlights the need for comparative and context-sensitive examination of institutional forces across different SME profiles.

First, coercive pressures were widely described by respondents as shaping compliance-oriented behaviour, while also being associated with short-term and reactive strategies among many SMEs. Whereas prior studies often treat regulation as a uniform driver of green adoption (Mafini & Muposhi, 2017; Zhou et al., 2023; Kamewor et al., 2024; Ouni & Ben Abdallah, 2024; Qadri et al., 2025), the findings here offer a more nuanced interpretation**:** regulatory volatility and frequent policy shifts were perceived as generating uncertainty, resource diversion, and what respondents referred to as “compliance chasing.” This aligns with recent calls to examine regulatory instability in relation to SME innovation trajectories (Biswas et al., 2023; Upadhyay et al., 2021). While blockchain was described as potentially mitigating some uncertainty through immutable records (Purusottama & Hasudungan, 2025), adoption under coercive pressure was not uniformly perceived as beneficial, particularly for smaller firms facing cost and capability constraints. From a theoretical standpoint, these findings suggest that the effects of coercive pressures are interpreted differently depending on SME conditions, shaping whether regulation is interpreted as enabling experimentation or necessitating defensive compliance.

Second, normative pressures particularly customer and supply-chain expectations for traceability and carbon data were consistently highlighted as salient by respondents**.** The frequently cited notion of *"no data, no deal"* resonates with research emphasising stakeholder-driven sustainability (Savelyeva & Park, 2022; Varma et al., 2024; Yan et al., 2024) and aligns with Spiga et al. (2024), who associate blockchain adoption with transparency demands. However, an interpretive reading of the findings suggests that normative pressures alone do not explain adoption outcomes. Respondents' accounts indicate that such pressures were translated into action only when SMEs perceived themselves to have sufficient operational and process capacity. This suggests that norms require internal process readiness to become consequential, rather than operating as self-sufficient drivers of change.

Third, mimetic pressures were interpreted as ambivalent in their implications**.** While imitation is often associated with accelerated diffusion of innovation (Nayak & Dhaigude, 2019; Popkova et al., 2023), consultants and directors described cases where imitation reflected symbolic rather than substantive adoption, captured in references to *"shiny tech for tech's sake"* (Friedman & Ormiston, 2022; Schinckus, 2020). This observation aligns with Milani et al.'s (2021) argument that insufficient process modelling limits transformative outcomes. The findings suggest that sectoral competition shapes how mimetic pressures are interpreted**, i**nfluencing whether imitation is approached strategically or adopted primarily for reputational signalling, consistent with institutional isomorphism theory.

A further theoretical contribution lies in the granular insight into process innovation challenges faced by SMEs operating under institutional pressure. Respondents' accounts indicate that limited digital and sustainability expertise often meant inefficiencies became visible only through BPM-oriented practices such as process mapping and benchmarking (Dumas et al., 2013; Van der Aalst, 2013; Jibril et al., 2024; Seuring & Müller, 2008). Even modest improvements were described as requiring digital upskilling and coordination across fragmented infrastructures issues that remain underexplored in green logistics research (Ezzi et al., 2023; Fang et al., 2025). From a theoretical standpoint, this highlights internal innovation capability as a contextual condition shaping how external pressures are interpreted and acted upon, rather than as a deterministic mediator.

Finally, the findings illuminate an important research gap. While much of the literature positions blockchain as a broadly applicable sustainability enabler, the evidence presented here underscores the contingent and uneven nature of its perceived effectiveness among SMEs. Better-resourced SMEs more frequently described converting institutional pressures into legitimacy or market access, whereas resource-constrained firms often associated blockchain adoption with symbolic compliance or limited environmental benefit. This suggests a theoretical need to integrate institutional pressures with firm-level capability considerations, rather than treating them as independent explanatory factors, when examining blockchain-enabled sustainability outcomes.

*B. Contributions to Research and Theoretical Implications*

This section articulates the theoretical contributions derived from the findings by offering an exploratory extension of existing theory**.** First, the study extends institutional theory by suggesting that institutional pressures alone do not fully explain digital sustainability transformation in SMEs. By examining blockchain adoption in green logistics, the findings indicate that coercive, normative, and mimetic pressures are interpreted and acted upon in conjunction with blockchain-enabled process changes, rather than operating as standalone drivers. This extends institutional theory into the context of emerging digital technologies by illustrating how legitimacy-seeking behaviour is intertwined with the development of digital capabilities in SMEs. While blockchain-enabled transparency was frequently associated with enhanced legitimacy and supply-chain credibility, the findings also reveal a sustainability paradox: compliance-oriented adoption may improve reputational standing without necessarily delivering proportional environmental benefits, and may in some cases increase digital resource consumption. This observation aligns with critiques of green digitalisation (Rudd et al., 2023; Yan et al., 2024) and underscores the importance of examining how institutional forces interact with internal organisational capabilities when evaluating sustainability outcomes.

Second, the study contributes by integrating institutional theory and BPM to provide a more inclusive explanation of blockchain-enabled sustainability change. Institutional theory helps explain why SMEs feel compelled to pursue sustainability-oriented digital initiatives, whereas BPM provides insight into how such initiatives are operationalised through process redesign, coordination, and capability development. This integration advances prior research that has largely applied these frameworks in isolation (Delmas & Toffel, 2008; Hoffman, 1999). The findings suggest that sustainability transformation is shaped by the alignment or misalignment between external legitimacy demands and internal process innovation capacity. In this sense, SME characteristics such as capital availability, workforce size, and sectoral context appear to condition how institutional pressures are interpreted and translated into process-level responses, offering a conceptual mechanism for understanding variation in adoption outcomes**.**

Third, the study advances theory by foregrounding SME heterogeneity as a key contextual condition in blockchain adoption for sustainability, an aspect that remains underdeveloped in much of the existing literature. The findings indicate that differences in business capital, turnover, workforce size, sector activity, and adoption maturity shape how SMEs approach blockchain-enabled sustainability initiatives. Medium-sized firms were more likely to describe strategic uses of blockchain linked to green procurement or competitive positioning, whereas smaller SMEs more frequently associated adoption with symbolic compliance or heightened operational strain. This challenges implicit assumptions of SME uniformity in sustainability and technology adoption research and responds to calls for more nuanced, context-sensitive theorisation**.**

Finally, the study refines theoretical understanding of blockchain-enabled process innovation in logistics (Kumar et al., 2023; Wang et al., 2023) by highlighting that applications such as emissions tracking, eco-routing, and carbon credit verification are perceived as delivering sustainability value only under certain organisational conditions**.** Respondents' accounts suggest that such tools are most meaningful when accompanied by internal learning, data management capability, and cross-organisational process integration. From this perspective, blockchain functions not merely as a technical artefact but as a boundary-spanning governance mechanism that can help align institutional expectations with operational practices provided that sufficient internal absorptive capacity exists**.**

*C. Limitations and future research direction*

This study's qualitative design provides context-specific insights into how institutional pressures and SME conditions shape blockchain-enabled sustainability in logistics. However, several limitations must be acknowledged. First, the study does not aim to establish causal relationships or empirically test moderating effects between institutional pressures, SME characteristics, and sustainability outcomes. The findings are based on interview narratives and thematic interpretation rather than formal hypothesis testing or statistical modelling. As such, references to variation in how coercive, normative, and mimetic pressures are experienced across SMEs should be understood as interpretive observations, not as evidence of empirically validated moderation effects. Future research could address this limitation through quantitative or mixed-method designs that explicitly test interaction effects between institutional pressures and firm-level characteristics.

Second, while the dual-informant strategy of interviewing both consultants and SME directors enhances triangulation, the sample size remains modest (12 consultants and 6 directors) and geographically restricted to the UK. This limits the generalizability of findings and raises the possibility that experiences may differ in other regulatory or market environments. Third, while directors provided valuable firm-level perspectives, the director sample was deliberately small and sector-specific. Their accounts should be interpreted as illustrative rather than representative of the broader SME population. Forth, the cross-sectional nature of the study captures perspectives at a single point in time. Given that both institutional pressures and blockchain adoption are rapidly evolving, a longitudinal design would be better suited to assess how process innovations and sustainability outcomes unfold over time. Accordingly, future research should consider longitudinal methods to track SME blockchain adoption and sustainability outcomes over time, and comparative studies across industries or regions to observe how differing institutional contexts influence adoption trajectories. Highlighting these opportunities will strengthen the generalizability and temporal understanding of blockchain-enabled green logistics.

Future research could address these limitations in several ways. Comparative studies across countries and regions would help illuminate how differing institutional contexts shape adoption

dynamics. Larger, mixed-method studies combining surveys with qualitative case studies could assess the relative prevalence and impact of specific institutional pressures across sectors. Longitudinal research is needed to evaluate the durability of sustainability outcomes, including whether blockchain adoption leads to genuine emissions reductions or primarily gains. In addition, future studies should explicitly account for SME heterogeneity**,** including differences in business capital, turnover, employee base, and adoption stage to identify which firms are most likely to achieve sustainable transformation versus adoption. Finally, future research should explore the integration of blockchain with other digital technologies, including artificial intelligence for route optimization, IoT for real-time monitoring, and digital product passports for supply chain transparency. Such studies would deepen understanding of how combined digital strategies can deliver scalable and holistic solutions for sustainable logistics.

*D. Implications for practice*

The findings of this study have important implications for SME leaders, consultants, and policymakers seeking to advance sustainable logistics. For SME leaders and consultants, the results show that blockchain technology should not be approached as a stand-alone solution but rather as part of a broader process transformation agenda. Its effective use depends on addressing logistics inefficiencies, closing skills gaps, and building organizational learning. This requires targeted investment in staff training, development of digital capabilities, and redesign of core business processes. Pilot projects, industry benchmarks, and peer learning initiatives can help SMEs build confidence, exchange best practices, and demonstrate value. Leaders are encouraged to begin with low-cost, high-impact applications such as emissions reporting, basic traceability, or route optimization before scaling to more complex blockchain systems. Importantly, SME leaders can leverage institutional pressures proactively by aligning blockchain adoption with regulatory expectations (coercive), responding to customer and supply chain sustainability demands (normative), and monitoring industry frontrunners to identify practices worth imitating (mimetic). Framing blockchain investment as a response to recognised external pressures can strengthen internal legitimacy, unlock funding opportunities, and accelerate adoption. The evidence also indicates that firm characteristics capital base, turnover, workforce size, and sector activity condition the extent to which blockchain adoption generates tangible benefits. Leaders should therefore carry out structured capacity assessments and cost–benefit analyses before committing to expensive digital projects. For consultants, the findings highlight the need to tailor advice to the specific resources and capacities of each SME rather than promoting uniform solutions. Consultants can help managers translate external pressures into actionable adoption roadmaps, starting with incremental changes and building toward advanced applications only when internal readiness allows. Consultants can also strengthen the ecosystem by linking SMEs to certification bodies, funding opportunities, and digital service providers, thereby reducing isolation and transaction costs.

For policymakers, the results point to clear areas of intervention. Regulatory uncertainty continues to constrain SME innovation, and thus stability, clarity, and standardization of environmental requirements should be prioritized. In addition, policies should not only mandate compliance but also support capacity-building. This includes targeted financial incentives for smaller firms, tax credits for verified emissions reductions, and grant schemes tied to measurable outcomes. Investment in national and regional digital skills programmes would help SMEs build in-house expertise, while demonstration projects can provide accessible models of good practice. Policymakers should also promote standardized sustainability metrics and carbon accounting systems to lower entry barriers and strengthen supply chain trust. Finally, supporting collaborative platforms or regional hubs where SMEs, consultants, and technology providers can co-develop solutions would accelerate sector-wide adoption.

## 6. Conclusion

This study set out to explore how SMEs interpret and respond to institutional pressures in relation to blockchain-enabled process innovation within green logistics. Drawing on qualitative insights from consultants and SME directors, the findings provide an exploratory, context-sensitive account of how coercive, normative, and mimetic pressures are perceived to influence engagement with blockchain-related initiatives in sustainability-oriented logistics practices. Rather than establishing causal relationships, the study illustrates how these pressures are understood, prioritised, and negotiated differently across SMEs, depending on firm size, resource availability, sectoral exposure, and internal process capabilities.

The findings suggest that blockchain is commonly viewed by participants as a supporting mechanism for transparency, traceability, and accountability, particularly in relation to emissions reporting and compliance documentation. However, respondents also emphasised that blockchain adoption is rarely pursued as a stand-alone solution and is typically embedded within broader digitalisation and process improvement efforts. From a BPM perspective, participants highlighted the importance of process mapping, workflow alignment, and capability development as enabling conditions for making blockchain-related initiatives operationally meaningful.

By adopting an explicitly exploratory and theory-informed approach, this study contributes to the literature by refining understanding of how institutional theory and BPM can be applied as interpretive lenses to examine emerging digital technologies in SME sustainability contexts. The insights presented should be understood as illustrative rather than generalisable, offering a foundation for future empirical investigation rather than definitive conclusions. Future research could build on this work through longitudinal designs, comparative cross-country studies, or mixed-method approaches to further examine how institutional environments, organisational processes, and digital technologies interact over time in shaping sustainability-related practices in SMEs.

**References**


Abdollahi, A., Sadeghvaziri, F., & Rejeb, A. (2023). Exploring the role of blockchain technology in value creation: a multiple case study approach. *Quality & Quantity*, *57*(1), 427-451.

Almutairi, K., Hosseini Dehshiri, S. J., Hosseini Dehshiri, S. S., Hoa, A. X., Arockia Dhanraj, J., Mostafaeipour, A., ... & Techato, K. (2023). Blockchain technology application challenges in renewable energy supply chain management. *Environmental Science and Pollution Research*, *30*(28), 72041-72058.

Al-Rakhami, M., & Al-Mashari, M. (2022). Interoperability approaches of blockchain technology for supply chain systems. *Business Process Management Journal*, *28*(5/6), 1251-1276.

Aslam, J., Saleem, A., & Kim, Y. B. (2023). Blockchain-enabled supply chain management: integrated impact on firm performance and robustness capabilities. *Business Process Management Journal*, *29*(6), 1680-1705.

Bag, S., Rahman, M. S., Gupta, S., & Wood, L. C. (2023). Understanding and predicting the determinants of blockchain technology adoption and SMEs' performance. *The International Journal of Logistics Management*, *34*(6), 1781-1807.

Behl, A., Jayawardena, N. S., Pereira, V., & Sampat, B. (2024). Assessing retailer readiness to use blockchain technology to improve supply chain performance. *Journal of Enterprise Information Management*, *37*(2), 673-697.

BEIS (2021). 2019 UK Greenhouse Gas Emissions.

Biswas, D., Jalali, H., Ansaripoor, A. H., & De Giovanni, P. (2023). Traceability vs. sustainability in supply chains: The implications of blockchain. *European Journal of Operational Research*, *305*(1), 128-147.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101.

Braun, V., & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis?. *Qualitative Research in Psychology*, *18*(3), 328-352.

CBRE. (2022). UK Logistics Market Trends Report November 2022.

Chavalala, M. M., Bag, S., Pretorius, J. H. C., & Rahman, M. S. (2022). A multi-method study on the barriers of the blockchain technology application in the cold supply chains. *Journal of Enterprise Information Management, 37*(2), 745-776.

Chen, Y., Hu, S., Zheng, Y., Xie, S., Yang, Q., Wang, Y., & Hu, Q. (2024). Coordinated optimization of logistics scheduling and electricity dispatch for electric logistics vehicles considering uncertain electricity prices and renewable generation. *Applied Energy, 364*, 123147.

Chen, H., & Ma, T. (2017). Optimizing systematic technology adoption with heterogeneous agents. *European Journal of Operational Research*, 257(1), 287-296.

Christodoulou, I., Rizomyliotis, I., Konstantoulaki, K., Nazarian, A., & Binh, D. (2024). Transforming the remittance industry: harnessing the power of blockchain technology. *Journal of Enterprise Information Management, 37*(5), 1551-1577.

CILT (2022). Green Logistics & Sustainable Transport: Industry Report. Chartered Institute of Logistics and Transport.

Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.

DEFRA (2023). An Overview of the Department for Environment, Food & Rural Affairs for the new Parliament 2023-24.

Defra (2018). The National Adaptation Programme and the Third Strategy for Climate Adaptation Reporting.

Dekker, R., Bloemhof, J., & Mallidis, I. (2012). Operations Research for green logistics–An overview of aspects, issues, contributions and challenges. *European Journal of Operational Research, 219*(3), 671-679.

Delmas, M. A., & Toffel, M. W. (2008). Organizational responses to environmental demands: Opening the black box. *Strategic Management Journal, 29*(10), 1027-1055.

Department for Transport (2023). Decarbonising Transport: A Better, Greener Britain. UK Government.

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review, 48*(2), 147-160.

DiMaggio, P. J., & Powell, W. W. (2000). The iron cage revisited institutional isomorphism and collective rationality in organizational fields. In *Economics meets sociology in strategic management* (pp. 143-166). Emerald Group Publishing Limited.

Dumas, M., La Rosa, M., Mendling, J., & Reijers, H. A. (2013). *Fundamentals of business process management* (Vol. 1, p. 2). Heidelberg: Springer.

Dyllick, T., & Hockerts, K. (2002). Beyond the business case for corporate sustainability. *Business Strategy and the Environment, 11*(2), 130-141.

Dubey, R., Gunasekaran, A., & Foropon, C. R. (2024). Improving information alignment and coordination in humanitarian supply chain through blockchain technology. *Journal of enterprise information management, 37*(3), 805-827.

Edwards-Jones, A. (2014). *Qualitative Data Analysis with NVIVO*.

Ezzi, F., Jarboui, A., & Mouakhar, K. (2023). Exploring the relationship between Blockchain technology and corporate social responsibility performance: empirical evidence from European firms. *Journal of the Knowledge Economy, 14*(2), 1227-1248.

Fang, C., Ullah, N., Batumalay, M., Al-Rahmi, W. M., & Alblehai, F. (2025). Blockchain technology and its impact on sustainable supply chain management in SMEs. *PeerJ Computer Science, 11*, e2466.

Fang, C., & Ma, T. (2018, February). Technology adoption optimization with heterogeneous agents and carbon emission trading mechanism. In *International Symposium on Integrated Uncertainty in Knowledge Modelling and Decision Making* (pp. 238-249). Cham: Springer International Publishing.

Fernandez-Vazquez, S., Rosillo, R., De la Fuente, D., & Puente, J. (2022). Blockchain in sustainable supply chain management: an application of the analytical hierarchical process (AHP) methodology. *Business Process Management Journal, 28*(5/6), 1277-1300.

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding and theme development. *International Journal of Qualitative Methods, 5*(1), 80-92.

Financial Times (2021). UK supply chain crisis to last until at least 2023, business leaders warn Financial Times, July 2023.

Friedman, N., & Ormiston, J. (2022). Blockchain as a sustainability-oriented innovation?: Opportunities for and resistance to Blockchain technology as a driver of sustainability in global food supply chains. *Technological Forecasting and Social Change, 175*, 121403.

Guest, G., Namey, E. E., & Mitchell, M. L. (2013). *Collecting Qualitative Data: A Field Manual for Applied Research*. Sage.

Hahn, T., Preuss, L., Pinkse, J., & Figge, F. (2014). Cognitive frames in corporate sustainability: Managerial sensemaking with paradoxical and business case frames. *Academy of Management Review*, *39*(4), 463-487.

Happy, A., Chowdhury, M. M. H., Scerri, M., Hossain, M. A., & Barua, Z. (2023). Antecedents and consequences of blockchain adoption in supply chains: a systematic literature review. *Journal of Enterprise Information Management*, 36(2), 629-654.

İndap, Ş., & Tanyaş, M. (2023). Blockchain applications for traceability and food safety in agri-food supply chain: cherry product application. *Journal of Enterprise Information Management*.

Jain, G., Singh, H., Chaturvedi, K. R., & Rakesh, S. (2020). Blockchain in logistics industry: in fizz customer trust or not. *Journal of Enterprise Information Management*, *33*(3), 541-558.

Jimenez-Castillo, L., Sarkis, J., Saberi, S., & Yao, T. (2024). Blockchain-based governance implications for ecologically sustainable supply chain management. *Journal of Enterprise Information Management*, 37(1), 76-99.

Kabeyi, M. J. B., & Olanrewaju, O. A. (2022). Sustainable energy transition for renewable and low carbon grid electricity generation and supply. *Frontiers in Energy Research*, *9*, 743114.

Kamewor, F. T., Kwateng, K. O., & Mensah, J. (2024). Green logistics practices: A bibliometric and systematic methodological review and future research opportunities. *Journal of Cleaner Production*, 143735.

KPMG (2023). The future of supply chain.

Li, D., Deng, L., Cai, Z., & Souri, A. (2022). Blockchain as a service models in the Internet of Things management: Systematic review. *Transactions on Emerging Telecommunications Technologies*, *33*(4), e4139.

Li, X., Sohail, S., Majeed, M. T., & Ahmad, W. (2021). Green logistics, economic growth, and environmental quality: evidence from one belt and road initiative economies. *Environmental Science and Pollution Research*, *28*, 30664-30674.

Logistics UK (2024). Innovation. Logistics UK.

Ma, T., Grubler, A., & Nakamori, Y. (2009). Modeling technology adoptions for sustainable development under increasing returns, uncertainty, and heterogeneous agents. *European Journal of Operational Research, 195*(1), 296-306.

Ma, S., Zhang, L. L., & Cai, X. (2024). Optimizing joint technology selection, production planning and pricing decisions under emission tax: A Stackelberg game model and nested genetic algorithm. *Expert Systems with Applications, 238*, 122085.

Mafini, C., & Muposhi, A. (2017). The impact of green supply chain management in small to medium enterprises: Cross-sectional evidence. *Journal of Transport and Supply Chain Management, 11*(1), 1-11.

McKinnon, A. (2010). Green logistics: the carbon agenda. *Electronic Scientific Journal of Logistics, 6*(3).

Merriam, S. B. (2015). Qualitative research: Designing, implementing, and publishing a study. In *Handbook of research on scholarly publishing and research methods* (pp. 125-140). IGI Global Scientific Publishing.

Milani, F., Garcia-Banuelos, L., Filipova, S., & Markovska, M. (2021). Modelling blockchain-based business processes: a comparative analysis of BPMN vs CMMN. *Business Process Management Journal, 27*(2), 638-657.

Moatari-Kazerouni, A., Pai, D. R., Chicas, A. E., & Keramati, A. (2024). How blockchain technology supports the business processes of clinical trials: a systematic review. *Business Process Management Journal, 30*(2), 388-410.

Mukherjee, A. A., Singh, R. K., Mishra, R., & Bag, S. (2022). Application of blockchain technology for sustainability development in agricultural supply chain: Justification framework. *Operations Management Research, 15*(1), 46-61.

Nayak, G., & Dhaigude, A. S. (2019). A conceptual model of sustainable supply chain management in small and medium enterprises using blockchain technology. *Cogent Economics & Finance, 7*(1), 1667184.

Nuryyev, G., Wang, Y. P., Achyldurdyyeva, J., Jaw, B. S., Yeh, Y. S., Lin, H. T., & Wu, L. F. (2020). Blockchain technology adoption behavior and sustainability of the business in tourism and hospitality SMEs: An empirical study. *Sustainability, 12*(3), 1256.

Obiri-Yeboah, H., Tetteh, F. K., Amoako, D. K., & Kyeremeh, A. (2025). Navigating digital transformation: a practice-based view of supply chain resilience and viability in small and medium enterprises. *Journal of Enterprising Communities: People and Places in the Global Economy*.

Office for National Statistics (ONS). (2023). Statistical bulletin, Low carbon and renewable energy economy, UK: 2021.

Ouni, M., & Ben Abdallah, K. (2024). Environmental sustainability and green logistics: Evidence from BRICS and Gulf countries by cross-sectionally augmented autoregressive distributed lag (CS-ARDL) approach. *Sustainable Development, 32*(4), 3753-3770.

Parmentola, A., Petrillo, A., Tutore, I., & De Felice, F. (2022). Is blockchain able to enhance environmental sustainability? A systematic review and research agenda from the perspective of Sustainable Development Goals (SDGs). *Business Strategy and the Environment, 31*(1), 194-217.

Popkova, E. G., Bogoviz, A. V., Lobova, S. V., Vovchenko, N. G., & Sergi, B. S. (2023). Blockchain, sustainability and clean energy transition. *Global Transitions, 5*, 64-78.

Porter, M. E., & Kramer, M. R. (2006). The link between competitive advantage and corporate social responsibility. *Harvard Business Review, 84*(12), 78-92.

Purusottama, A., & Hasudungan, A. (2025). Blockchain adoption for enhancing value chain governance. *Business Process Management Journal*.

Qadri, H. M. U. D., Ali, H., & Mustafa, A. U. (2025). Relationship between environmental performance indices and blockchain-based sustainability-focused companies: Evidence from countries in Europe and America. *Regional Sustainability, 6*(2), 100214.

Rudd, M. A., Bratcher, L., Collins, S., Branscum, D., Carson, M., Connell, S., & Porter, D. (2023). Bitcoin and its energy, environmental, and social impacts: An assessment of key research needs in the mining sector. *Challenges, 14*(4), 47.

Saunders, M. N., & Townsend, K. (2016). Reporting and justifying the number of interview participants in organization and workplace research. *British Journal of Management, 27*(4), 836-852.

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.

Savelyeva, T., & Park, J. (2022). Blockchain technology for sustainable education. *British Journal of Educational Technology, 53*(6), 1591-1604.

Schinckus, C. (2020). The good, the bad and the ugly: An overview of the sustainability of blockchain technology. *Energy Research & Social Science, 69*, 101614.

Scott, W. R. (2013). *Institutions and Organizations: Ideas, Interests, and Identities*. Sage Publications.

Sedlmeir, J., Buhl, H. U., Fridgen, G., & Keller, R. (2020). The energy consumption of blockchain technology: Beyond myth. *Business & Information Systems Engineering*, *62*(6), 599-608.

Shah, A., Soomro, M. A., Zahid Piprani, A., Yu, Z., & Tanveer, M. (2023). Sustainable supply chain practices and blockchain technology in garment industry: An empirical study on sustainability aspect. *Journal of Strategy and Management*.

Sharma, M., Luthra, S., Joshi, S., Kumar, A., & Jain, A. (2023). Green logistics driven circular practices adoption in industry 4.0 Era: A moderating effect of institution pressure and supply chain flexibility. *Journal of Cleaner Production, 383*, 135284.

Sharma, R., Samad, T. A., Chiappetta Jabbour, C. J., & de Queiroz, M. J. (2025). Leveraging blockchain technology for circularity in agricultural supply chains: evidence from a fast-growing economy. *Journal of Enterprise Information Management*, *38*(1), 32-67.

Sikder, M., Wang, C., Rahman, M. M., Yeboah, F. K., Alola, A. A., & Wood, J. (2024). Green logistics and circular economy in alleviating CO2 emissions: Does waste generation and GDP growth matter in EU countries?. *Journal of Cleaner Production, 449*, 141708.

Kumar Singh, S., Singh, A., Jenamani, M., & Rana, N. P. (2024). Analyzing barriers of integrated RFID-blockchain adoption in the Indian public distribution systems. *Journal of Enterprise Information Management*, *37*(2), 355-380.

Singh, S. K., & Jenamani, M. (2024). ProcessChain: A blockchain-based framework for privacy preserving cross-organizational business process mining from distributed event logs. *Business Process Management Journal, 30*(1), 239-269.

Spiga, G., Ahmad, S. Z., & Yeoh, W. (2024). Blockchain adoption impact on real estate performance: the mediating role of real estate and blockchain transparency. *Business Process Management Journal, 30*(6), 1874-1894.

Sun, X., Yu, H., Solvang, W. D., Wang, Y., & Wang, K. (2022). The application of Industry 4.0 technologies in sustainable logistics: a systematic literature review (2012–2020) to explore future research opportunities. *Environmental Science and Pollution Research*, 1-32.

Tetteh, F. K., Owusu Kwateng, K., & Mensah, J. (2025). Enhancing carbon neutral supply chain performance: can green logistics and pressure from supply chain stakeholders make any differences?. *Sustainability Accounting, Management and Policy Journal*, *16*(2), 521-551.

Upadhyay, A., Mukhuty, S., Kumar, V., & Kazancoglu, Y. (2021). Blockchain technology and the circular economy: Implications for sustainability and social responsibility. *Journal of Cleaner Production*, *293*, 126130.

Van der Aalst, W. M. (2013). Business process management: a comprehensive survey. *International Scholarly Research Notices*, *2013*(1), 507984.

Varma, A., Dixit, N., Ray, S., & Kaur, J. (2024). Blockchain technology for sustainable supply chains: A comprehensive review and future prospects. *World Journal of Advanced Research and Reviews*, *21*(3), 980-994.

Weiland, S., Hickmann, T., Lederer, M., Marquardt, J., & Schwindenhammer, S. (2021). The 2030 agenda for sustainable development: transformative change through the sustainable development goals?. *Politics and Governance*, *9*(1), 90-95.

Wu, J., & Tran, N. K. (2018). Application of blockchain technology in sustainable energy systems: An overview. *Sustainability*, *10*(9), 3067.

Yan, F., Chen, L., & Jia, F. (2024). Environmental, social, and governance disclosure in supply chains: a systematic literature review. *Production Planning & Control*, 1-22.

Zhou, Q., Huang, H., Zheng, Z., & Bian, J. (2020). Solutions to scalability of blockchain: A survey. *Ieee Access*, *8*, 16440-16455.

Zhou, B., Siddik, A. B., Zheng, G. W., & Masukujjaman, M. (2023). Unveiling the role of green logistics management in improving SMEs' sustainability performance: do circular economy practices and supply chain traceability matter?. *Systems*, *11*(4), 198.

## Appendix A:

### Interview Instrument

Please describe your professional background (for consultants: your consulting experience and the typical SMEs you advise; for directors: your company, size, sector, and role), including your experience in blockchain-enabled green logistics or digital transformation.

What are the main challenges SMEs face (or your firm has faced) when adopting blockchain-supported sustainable or green logistics practices?

How have recent government policies or regulations affected SMEs' strategies (or your company's decisions) regarding environmental compliance and blockchain adoption?

How do SMEs (or your company) respond to regulatory uncertainty or frequent changes in compliance requirements? Does this create hesitation or confusion about investing in blockchain technology?

How significant are customer expectations and demands in motivating SMEs (or your company) to adopt blockchain for sustainable logistics?

What influence do industry standards, benchmarking, or supply chain partner requirements have on SMEs' (or your company's) adoption of blockchain solutions in green logistics?

To what extent do SMEs (or your company) imitate competitors or follow industry leaders when considering blockchain adoption?

What process mapping, redesign, or benchmarking methods are used (for consultants: in your advisory work; for directors: within your company) to improve logistics or sustainability, and how effective are they in integrating blockchain into logistics workflows?

What barriers do SMEs (or your company) encounter when integrating digital solutions such as blockchain? Are skills, budgets, or technical challenges most limiting?

What skills, resources, or supports are most lacking among SMEs (or within your company) when trying to innovate in green logistics through blockchain adoption, and how are these gaps addressed?

Can you provide examples where blockchain adoption led to measurable improvements (e.g., cost savings, efficiency gains, emissions reductions, transparency)?

How do external pressures (regulation, customers, supply chain) and internal capabilities (skills, resources) interact to determine whether SMEs (or your company) achieve successful and sustainable outcomes with blockchain innovation?

**Length of Interview: _____**

**Interview Code: _____**