Chapter 14
Trust Through Transparency:
Blockchain-Enabled Supply Chain Traceability for Smart Urban Ecosystems

Yahaya Saidu
https://orcid.org/0009-0000-8909-8806
Universiti Teknologi PETRONAS, Malaysia & Taraba State University, Jalingo, Nigeria

Suwaiba Siuto Adamu
https://orcid.org/0009-0005-9522-2777
Taraba State University, Jalingo, Nigeria

Shuhaida Mohamed Shuhidan
Universiti Teknologi PETRONAS, Malaysia

Jameel Shehu Yalli
https://orcid.org/0009-0006-2602-4862
Universiti Teknologi PETRONAS, Malaysia

Dahiru Adamu Aliyu
https://orcid.org/0009-0009-9803-3604
Universiti Teknologi PETRONAS, Malaysia

Hussaini Mamman
https://orcid.org/0009-0005-0404-3125
Universiti Teknologi PETRONAS, Malaysia

ABSTRACT

As urban ecosystems evolve into data-intensive infrastructures, the transparency of supply chains has become pivotal to cybersecurity, governance, and trust. This chapter explores how blockchain, initially developed for decentralized finance, is now foundational for traceability in smart urban logistics. It examines its convergence with IoT and governance systems to enable tamper-resistant, auditable, and privacy-aware data flows. The chapter outlines blockchain's core features, immutability, decentralization, smart contracts, and permissioned architectures, and maps

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these to urban sectors like food safety, pharmaceuticals, procurement, and waste. Real-world deployments across Asia, Europe, and North America demonstrate its role in enhancing collaboration, preventing fraud, and supporting compliance with regulations such as the GDPR. The chapter also identifies adoption challenges and offers ethical governance models and a strategic roadmap to position blockchain as a socio-technical foundation for trust, sovereignty, and equity in the smart city era.

1. INTRODUCTION: URBAN SUPPLY CHAINS IN THE AGE OF SMART CITIES

Modern urban life relies on the continuous circulation of goods and information. Supply chains (SC), which link production, distribution, and consumption, serve as critical infrastructures for food security, public health, transportation, and emergency response (Sarkheyli & Sarkheyli, 2019). As cities become increasingly interdependent and data-driven, ensuring the integrity and traceability of these chains is no longer a purely operational task but a strategic imperative for resilience, public trust, and equitable service delivery.

Urban supply chains(USC) sustain the ecosystemic metabolism of cities. Whether transporting perishable food, delivering vaccines, or maintaining energy systems, they enable cities to function effectively and adapt to crises. Yet, they often remain invisible until disruptions expose their fragility (Ding et al., 2023). The COVID-19 pandemic underscored this vulnerability: shortages of medical equipment and essential goods emerged not from absolute scarcity but from fragmented coordination, hoarding, and the absence of real-time data (Agarwal et al., 2022). These failures reveal deeper structural problems rooted in limited visibility and reliance on centralized, siloed infrastructures.

Traditional logistics models perpetuate trust asymmetries and data fragmentation. Legacy systems often depend on intermediaries, proprietary databases, and batch-based recordkeeping, creating vulnerabilities to fraud, counterfeiting, and manipulation. Centralized authorities also introduce single points of failure; a compromised database or ERP platform can paralyze an entire urban supply chain (Jinor & Bridgelall, 2024; Theodorou & Sklavos, 2019). In complex metropolitan environments, where municipal agencies, private vendors, and community stakeholders must coordinate, fragmented data stewardship undermines both cybersecurity and systemic resilience.

The lack of transparency also limits accountability to consumers and regulators. Citizens rarely have reliable means to verify the origin, quality, or ethical sourcing of goods, while city managers often lack audit trails necessary to enforce environmental and social compliance. From contaminated food in Europe to counterfeit