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A Study on Enhancing Transparency and Efficiency in Logistics Supply Chains through Blockchain Technology

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Abstract: *Blockchain's decentralized, impenetrable ledger holds promise for resolving long-standing information gaps and process hiccups in international logistics. The ability of blockchain to improve traceability, automate processes, and lower fraud is evaluated in this study along with adoption barriers. Using a mixed-methods design that includes curriculum and market reports, 15 expert interviews, two live case-study platforms (Komgo and Unblocked Cash), and secondary data on more than 200 logistics blockchain pilots, we find that blockchain consistently provides (i) end-to-end visibility improvements of at least 60%, (ii) cycle-time reductions of 20–45% through smart-contract automation, and (iii) material fraud reduction in high-risk lanes (food, pharma). The integration of outdated systems, a lack of skills, and unclear cross-border standards are major challenges. A phased rollout with open APIs and sector-specific governance, spearheaded by a consortium, is advised.*

Keywords: Supply Chain Management Blockchain

I. INTRODUCTION

Supply chain opacity leads to delays, exaggerated costs, and counterfeiting. Conventional databases can be changed and are divided into different sections. A single, unchangeable "source of truth" is dispersed by blockchain, facilitating synchronous data exchange, smart-contract execution, and cryptographic inspection. However, adoption in the actual world is not uniform. The question posed in this article is: How and under what circumstances may blockchain significantly improve supply chain transparency and efficiency?

II. RESEARCH, IDENTIFY AND GATHER IDEAS

Transparency & Traceability: Tian (2016) and Büyüközkan & Göçer (2018) demonstrate how blockchain reduces recall and authenticity checks in the food and pharmaceutical industries from days to seconds.
Process Efficiency: According to Kshetri (2018) and Treiblmaier (2018), smart contracts result in a 30% reduction in paperwork and a quicker clearing process through customs.
Security and Fraud Prevention: Hughes et al. (2019) observe counterfeit shrinkage in expensive items, while Crosby et al. (2016) emphasize cryptographic assurances.
Integration cost, scalability, and regulatory ambiguity are mentioned as adoption barriers by Mougayar (2016) and Saberi et al. (2019).
Research Gap: There aren't many cross-sector, longitudinal studies that compare blockchain platforms or measure large-scale efficiency gains.

III. EXPLANATION OF RESEARCH: INVESTIGATIONS AND RESULTS

The study went through seven consecutive examinations, each of which provided evidence for the next, to determine how blockchain may actually improve logistics' transparency.

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3.1 Scanning of the Landscape

First, 204 publicly disclosed logistics blockchain projects that were created between 2014 and mid-2024 were gathered from peer-reviewed databases, Crunchbase, Gartner, and CoinDesk. In addition to mapping adoption peaks, our scan revealed the five most popular use cases and the major blockchains (Ethereum and Hyperledger), with product trace and track leading at 66% of trials.

3.2 Case-Study in-depth analyses

From this universe, two established deployments were chosen for long-term study: Oxfam/Sempo "Unblocked Cash" and Komgo, a Quorum-based trade finance platform utilized by 15 international banks and commodities merchants.Vanuatu's primary online platform for humanitarian money transactions is Ethereum. User interviews, cost files, and internal dashboards produced concrete ROI figures (e.g., 70 percent reduction in paperwork time for Unblocked Cash; 30 to 40 percent acceleration of cash flow for Komgo).

3.3 Expert Talks

Interviews were conducted utilizing a semi-structured protocol with five blockchain architects and ten top logistics executives (ocean carrier, 3PL, forwarder, customs broker, and insurance). Regulatory friction, integration pain spots, and technological fit were all examined. NVivo was used to code the transcripts in order to identify recurring themes.

3.4 Expert Examination

An online survey including 60 multiple-choice and Likert scale items was distributed to supply chain experts through industry associations and LinkedIn groups; 48 completed responses were examined.

3.5 Evaluation of Comparative Platforms

This was followed by a reclassification of the projects by maturity level and blockchain stack. While Ethereum had more dormant start-ups, Hyperledger pilots had a greater percentage of market-ready status (36%) than Ethereum pilots (21%), suggesting that platform selection affects viability.

3.6 Sector Particular Drilling

Agriculture/Grocery and Freight/Logistics were separated for time series analysis as they combined accounted for 57% of all pilots. While freight initiatives maintained a greater Ethereum share but had a higher dropout rate, agriculture projects switched from Ethereum to Hyperledger after 2018, which coincided with stricter food safety regulations.

3.7 Constructing and Verifying

In the end, the results of surveys, interviews, case evidence, and data scans were triangulated. To verify convergent validity, descriptive data were compared to qualitative insight

IV. CONCLUSION

The integration of blockchain technology through collaborative, standards-based models is the only way to demonstrate how blockchain improves logistics visibility and efficiency. The working capital gains of early adopters range from 30 to 40 percent; laggards run the danger of data integrity penalties and competitive attrition. Future study should investigate the integration of blockchain, AI, and IoT for predictive logistics and conduct multi-year ROI studies.

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