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Possibilities of Using Blockchain Technology in Transportation

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INTRODUCTION

Blockchain technology, originally known for cryptocurrencies, is now gaining traction in sectors like transportation due to its ability to provide secure, transparent, and immutable data records. While adoption is still limited due to technical and legal challenges, early pilot projects show strong potential for future.

Key challenges include a lack of understanding among industry professionals, insufficient legal frameworks, interoperability issues with existing systems, and concerns about scalability and energy consumption. Stakeholders: Transport firms, tech providers, logistics companies, insurers, customs agencies, end users.

Research Objectives:
Assess blockchain's benefits and challenges in transport.
Expected Impact:
Improve transparency, efficiency, and digital transformation in the sector.

MATERIALS, METHODS & IMPLEMENTATION

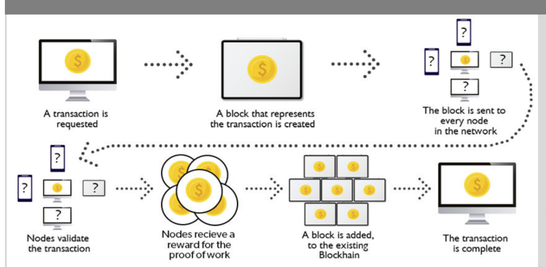

Fig. 1. The principle of blockchain technology operation ("https://media.geeksforgeeks.org/wp-content/uploads/20220518004235/BlockchainF1.jpg," 2024).

The study used a qualitative research approach, combining a literature review with case study analysis. Key sources included scientific publications on blockchain in transport and EU digital mobility policies. Real-world case studies (e.g., Deutsche Bahn, TradeLens, e-CMR, KrisPay) were analyzed to evaluate blockchain applications across different transport modes. A comparative assessment was then conducted to understand feasibility and effectiveness across rail, road, air, and water transport.

RESULTS

The research confirms that blockchain improves data transparency, security, and efficiency in transportation. It highlights blockchain's role in enhancing interoperability, process automation, and fraud prevention, especially in logistics and digital documentation.
Blockchain can therefore rightly be considered the technology of the future in the transport sector. However, several initial attempts to utilize blockchain technology in conjunction with transportation, primarily in the form of pilot projects, can already be observed today. These are primarily attempts to test the operation of a new concept involving blockchain, with efforts underway in rail, road, air, and even water transport.

Practical Applications:
Blockchain is being tested in real-world transport cases:

- Rail transport: Deutsche Bahn's tokenized ticketing system.
- Road transport: Integration of e-CMR for digital freight tracking.
- Air transport: KrisPay digital wallet for frequent flyer programs.
- Water transport: TradeLens for cargo tracking (despite its discontinuation, it demonstrated blockchain's logistics potential).

Table 1. Application possibilities of blockchain technology in the transportation sector (source: authors).

Application areas	Rail transport		Road transport		Air transport		Water transport	
	Passenger	Freight	Passenger	Freight	Passenger	Freight	Passenger	Freight
Transport course monitoring	Low	High	Low	High	Low	High	Low	High
Travel/Accompanying documents	Middle	High	Middle	High	Middle	High	Middle	High
Payment system	Low	Middle	Low	Middle	Middle	Middle	Low	Middle
Customer service	High	High	High	High	High	High	High	High
Interoperability support	High	High	High	High	High	Low	High	Middle

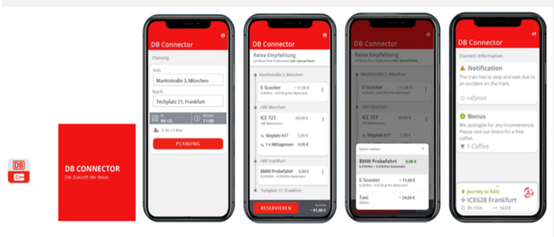

Fig. 2. A sample DB Connector application using blockchain technology (Unibright.io, 2018).

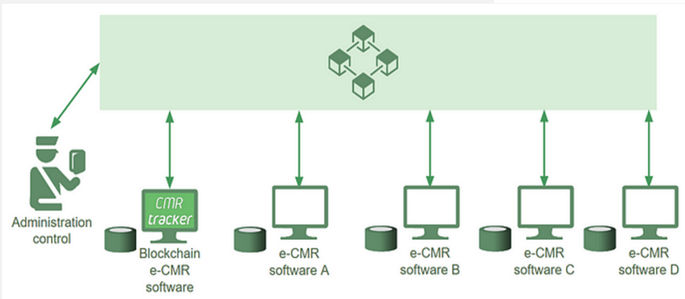

Fig. 3. Example of integrating blockchain technology and e-CMR (TransFollow, 2022).

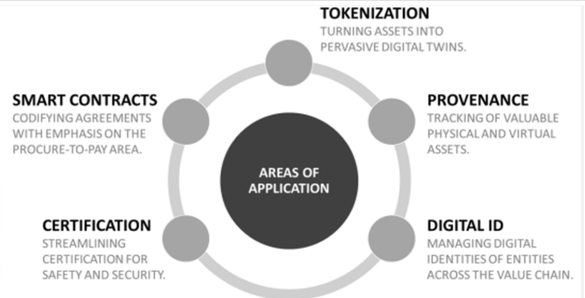

Fig. 4. Key application areas of blockchain technology in the aviation sector (Goudarzi and Martin, 2018).

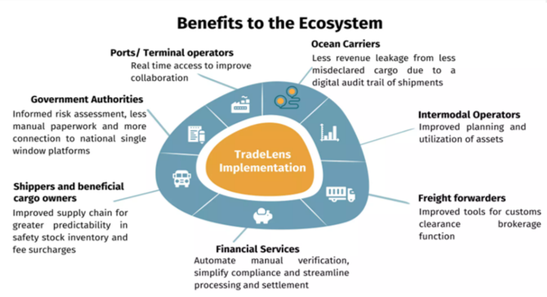

Fig. 5. Expected implementation areas of the TradeLens project (Singh et al., 2022).

CONCLUSION & IMPLEMENTATION PATH

The study confirms that blockchain technology can significantly improve transparency, efficiency, and trust in transportation systems. Real-world case studies from rail, road, air, and maritime transport highlight its effectiveness in tracking, documentation, automation, and data security. However, technological, legal, and organizational challenges currently limit its broader adoption.
Blockchain has the potential to revolutionize the transport industry by enabling digital transformation, reducing fraud, and streamlining complex logistics processes. Its application supports sustainability, enhances customer service, and improves coordination between stakeholders across the supply chain.

Further Research Areas:

- Enhancing blockchain scalability and transaction speed
- Developing off-chain and hybrid solutions for real-time use
- Improving interoperability with existing systems (ERP, TMS)
- Establishing legal frameworks and standards for blockchain documents (e.g., e-CMR)
- Promoting education and awareness to increase adoption in the transport sector

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