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Speeding up negotiations for prototypes in an industrial project thanks to blockchain

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Abstract. This paper explores how blockchain technology can accelerate negotiations within industrial supply chains, focusing on prototype management in the automotive sector. Through a real case study involving a car manufacturer and a tier 1 supplier, we analyse the complex workflow from prototype request initiation to purchase order issuance. The study identifies critical bottlenecks that hinder process efficiency, such as communication delays and prolonged negotiations. By simulating blockchain-based transactions on the Ethereum platform, our analysis quantifies the costs associated with decentralised record-keeping and smart contract execution. The findings demonstrate that blockchain enhances transparency, traceability, and data integrity while reducing reliance on intermediaries and mitigating negotiation delays. Despite challenges such as cryptocurrency volatility and the need for operational adaptations, our results highlight blockchain's potential to streamline supply chain interactions and lower overall transaction costs. This work contributes to the supply chain optimisation and digital transformation literature by providing empirical insights and practical guidelines for integrating blockchain solutions in complex industrial environments.

Keywords: Blockchain, Supplier, Prototype, Automotive Industry.

1 Introduction

A vast body of research in supply chain management has long explored governance mechanisms to reduce transaction costs [1]. More recently, theoretical contributions have highlighted blockchain technology's potential to lower these costs further [2]. Blockchain promises enhanced cooperation, improved sourcing visibility, reduced audit requirements, increased trust, and greater transparency and traceability throughout the supply chain [3]. Its ability to integrate financial, physical, and digital data addresses persistent issues such as complex record-keeping, traceability breaches, fraud, and limited visibility. It also reduces data redundancy and ensures that inventories are continuously updated. Moreover, smart contracts can automate processes such as deliveries and payments [4].

As a decentralised, secure, and transparent system, blockchain relies on a network of nodes to validate and link transactions into immutable blocks [5]. Smart contracts—

self-executing agreements triggered by predefined conditions—eliminate the need for intermediaries, reducing traditional transaction costs. This peer-to-peer approach minimises risks of opportunistic behaviour, as blockchain transactions are immutable and irreversible. Schmidt and Wagner [2] illustrate how transaction cost theory supports blockchain's applicability in reducing costs across various supply chain contexts.

Recent studies have explored blockchain's role in re-engineering supply chain processes and financing models. Chang et al. [6] demonstrate that blockchain facilitates open supply chain management by promoting transparency and reducing complexity through re-engineered workflows that streamline information sharing and coordination. Similarly, Chen et al. [7] investigate blockchain-based finance solutions that alleviate financing barriers for SMEs by enhancing trust and reducing information asymmetries. However, they caution that operational and platform fees introduce new cost factors. Zhou et al. [8] add that, from a game-theoretic perspective, the decision to adopt blockchain is driven by the potential for cost reduction and economic competitiveness.

Despite these advantages, blockchain does not eliminate transaction costs. Sun et al. [9] note that while costs may decline as validation technologies and smart contracts evolve, certain expenses persist, particularly in permissionless networks. Vatiero [10] also highlights limitations, such as the rigidity of smart contracts and the risk of unilateral protocol modifications. Nevertheless, smart contracts can offer more immediate dispute resolution when legal intervention is slow. Although firms must carefully assess the organisational and operational adaptations required, blockchain's potential to enhance supply chain governance and reduce transaction costs appears to outweigh its drawbacks. The following sections present a case study that quantifies blockchain-related costs, offering valuable insights into its benefits for supply chain management.

2 Real Case Description

We will describe a real case in an industrial environment: a prototype management request within a project for a new vehicle development. All the details presented in this paper aim to be clear enough to ensure an accurate understanding of the case while preserving confidentiality. It is important to note that one of the paper's authors was directly involved in this case as a Senior Project Manager.

A carmaker addresses this prototype request to a tier 1 supplier, and it will allow the project team to test some features of the future vehicle without waiting for the final "off tool & off process" parts. This section will describe how different stakeholders managed this situation in real life. In the next section, we will propose an alternative using blockchain technology to optimise the schedule and costs linked to negotiation.

2.1 Involved Stakeholders

The key stakeholders in the prototype application are organised by department and span the car manufacturer and its first-tier supplier. On the carmaker side, this includes a Logistics Technician in the Prototype Logistics department, a Vehicle Prototype Buyer in the Prototype Procurement division, and an Engineering Project Management team comprising a Junior Project Manager, a Senior Project Manager, and a Project Director.

On the supplier side, key roles are held within Commercial and Procurement by an Account Manager and a Key Account Manager. At the same time, a Project Manager represents the supplier's Engineering Project Management.

On the carmaker side, the process begins with Prototype Logistics, where a Logistics Technician initiates the request for prototypes and obtains the associated quotation. In Prototype Procurement, the Vehicle Prototype Buyer evaluates the supplier's quotation against the contract terms, negotiates any price deviations, and, if necessary, escalates these issues to Engineering Project Management. Within this department, the structured team ensures that technical doubts are resolved and that any cost deviations are thoroughly validated through an extra-cost committee.

On the supplier side, the Commercial & Procurement department is responsible for preparing the quotation through an Account Manager. A Key Account Manager manages higher-level discussions if the negotiation becomes more complex. The supplier's Engineering Project Management, led by a Project Manager, supports technical issues and coordinates directly with the carmaker's project management team.

2.2 Interactions Among Stakeholders

Once the stakeholder roles are defined, the workflow extends from the project's initial decision on the number of prototypes to the purchase order issuance after the final price is set. The process begins with launching a prototype request, confirming feasibility, and obtaining the supplier's quotation (Fig. 1). A key stage is the negotiation phase, which is triggered when the quotation exceeds the contract reference cost (λ).

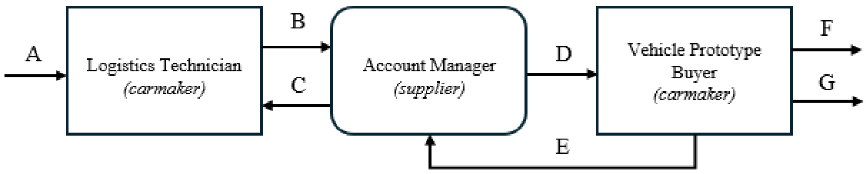

Fig. 1. Prototypes request workflow with main actions (A to F, see Table 1) and stakeholders.

Table 1 shows the main actions stakeholders must take in prototype management.

Table 1. Main actions to be performed by stakeholders in prototype management

Action label	Action description	Person in charge
A	Number of prototypes (first input)	Several stakeholders
B	Launch prototypes request	Logistics Technician
C	Availability/feasibility confirmation	Account Manager (supplier)
D	Prototypes quotation	Account Manager (supplier)
E	Negotiation (if cost > λ)	Several stakeholders
F	Purchase order emission (if cost = λ)	Vehicle Prototype Buyer
G	Purchase order emission after negotiation agreement and "extra-cost" committee validation (if cost remains > λ)	Vehicle Prototype Buyer

Initially, the supplier's Account Manager presents a price at 3λ, prompting extensive exchanges between the Vehicle Prototype Buyer and the Account Manager to clarify the cost breakdown. When these discussions do not yield an agreement, the process escalates into an upper-level negotiation loop—employing a Harvard methodology [11] led by senior management—to resolve the discrepancy. Although the escalated negotiations are resolved quickly, the overall process spans nearly one month due to the issue's complexity.

Additionally, a delay in confirming prototype availability (Action C), caused by the Account Manager missing a critical email from the Logistics Technician, highlights an opportunity for optimisation, potentially addressable through blockchain technology.

2.3 Resolution of the Case

An upper-level negotiation loop resolved the impasse. The Senior Project Manager defended the standard cost (λ) by reminding the supplier's Key Account Manager of the contract terms. Initially, the supplier reduced its quotation from 3λ to 2λ. After the Project Director proposed a Steering Committee, which could not be convened due to scheduling conflicts, the Senior Project Manager quickly offered a final counterproposal of 1.5λ. This offer was accepted by supplier and validated in extra cost committee.

Although blockchain technology cannot replace human negotiation skills, it could provide early alerts to flag prolonged negotiations, substantially reducing the overall negotiation time. Such scenarios are prevalent within project environments, and managing supply chains in these particular contexts is likely more complex than in industrial supply chains operating under steady-state conditions. Consequently, the adoption of blockchain technology may be worthwhile. The following section explores how blockchain can bring additional benefits in similar scenarios.

3 Blockchain Simulation. Results

To illustrate the operational costs of blockchain-based transactions within a supply chain, we use an educational blockchain simulation tool for the supply chain. This tool provides a general idea for a first approach, but we are also working on adapting this educational platform to model better the real case described above. For this first approach, we designed a simulation involving three actors and the purchase of a prototype. Each blockchain operation incurs a cost in this simulation: external transactions require creating smart contracts, while internal transactions involve only data registration. The total cost observed was 0.0035 Ether, equivalent to 8.96154 Euros (based on exchange rates as of 24 February 2025).

In Fig. 2, we present screenshots of the blockchain simulation. The simulation highlights how blockchain introduces significant transparency, traceability, and data integrity into supply chains while reducing costs. However, cryptocurrency volatility poses challenges for operations requiring stable, recurring payments. To address this, real-world implementations might deploy a custom ERC-20 token pegged to a stable asset or fiat currency, offering predictable cost structures, interoperability, streamlined, automated payments via smart contracts, and transparent transaction records.

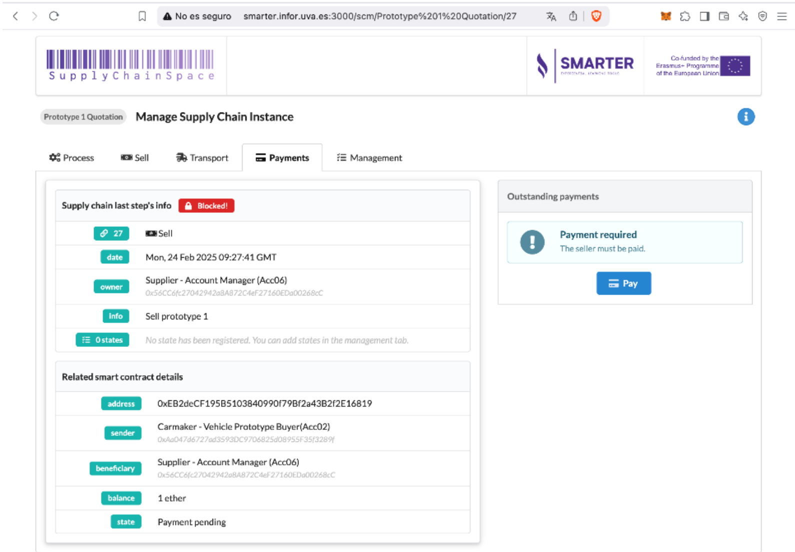

Fig. 2. Screenshot of the blockchain platform**.**

These findings demonstrate potential benefits of integrating blockchain technology into supply chain management. Nonetheless, managers should perform a detailed cost-benefit analysis to balance potential cost reductions with associated expenses linked to on-chain activities, ensuring that the overall efficiency justify the implementation.

4 Discussion and conclusion

This study presents a simulation that identifies the expenses of using blockchain technology for economic transactions in a small supply chain. We detail the costs incurred per transaction from network security, efficiency, and the computational resources required for on-chain operations. Thus, any change to the blockchain incurs a fee based on transaction complexity and data volume, consistent with the SaaS model.

Prior research shows that blockchain lowers the transaction costs of search, communication, and contract enforcement. Several authors analysed Ethereum data and concluded that the platform functions as a financial marketplace for payment. They argue that demand factors, such as utilisation rates and transaction types, primarily drive fees, suggesting that blockchain operates like an "efficient market." Nevertheless, supply chain designers must account for blockchain-related expenses when planning implementations. Other aspects to be considered for the application of blockchain in supply chains are the difficulty to implement this technology when logistic flows are complex and already well established, as well as a culture fact: as blockchain is very technical, it is not evident to explain to company general managers their benefits in a simple way.

A limitation of this study is that it presents a simplified, permissionless simulation of blockchain in a supply chain, so caution is needed when generalising the results to more complex systems or blockchains with different governance. Moreover, the simulation reflects a single point in time with costs denominated in volatile cryptocurrencies. Future research could address this by using a custom ERC-20 token pegged to a stable asset (e.g., 1 EUR), thereby reducing currency fluctuation risks, lowering fees, and improving cost predictability in blockchain-enabled supply chain operations. In addition, we are adapting the simulation platform to model the real case more accurately, which will allow us to extract broader conclusions. It will be presented in future work.

Ethical statement. Participation was voluntary, individuals wer anonymised and no data or biological material has been taken.

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