A Blockchain-based Reputation System for Trust Management in Collaborative Multi-Stakeholder Settings

Lívia Maria Bettini de Miranda[1], Rodrigo Dutra Garcia[2], Jo Ueyama[2], Gowri Ramachandran[3], Fábio Müller Guerrini[1]

[1]São Carlos School of Engineering, University of São Paulo (USP), 13566-590 – São Carlos – SP – Brazil

[2]Institute of Mathematics and Computer Science, University of São Paulo (USP), 13566-590 – São Carlos – SP – Brazil

[3]School of Computer Science, Queensland University of Technology – Brisbane Queensland – Australia

{livia.miranda99,rgarcia}@usp.br, joueyama@icmc.usp.br

g.ramachandran@qut.edu.au, guerrini@sc.usp.br

Abstract. *Organizations collaborate in industrial networks to share business risks, innovate, and deliver value-added products and services, relying on trust management. However, mistrust among stakeholders arises due to a lack of information transparency, coordination issues, and incentive misalignment. To overcome this problem, this work proposes a decentralized reputation system based on blockchain, smart contracts, and tokenization. Particularly, we address the problem of selecting partners for multi-stakeholder production through their token-based reputation. Our proof-of-concept evaluation results show that the proposed system is agnostic for Ethereum Virtual Machine-based (EVM) blockchains with low computational overhead.*

1. Introduction

In dynamic business environments, organizations collaborate through a network of customers, partners, and suppliers as a strategy to share business risks and foster innovation in a multi-stakeholder approach to deliver value-added products and services [Kostić and Sedej 2021, Winkler et al. 2023]. Trust management is crucial for the collaborative success of business partnerships in industrial networks [Conway and Garimella 2020, Schaffers 2018]. This applies, for instance, to the automotive industry, which needs to coordinate and align hundreds of suppliers and manufacturers given globalization [Große et al. 2024].

However, inter-organizational collaboration faces several challenges in practice, such as mistrust among parties, lack of coordination, incentive misalignment, and complexity in dealing with the interplay of collaboration and competition among stakeholders to create business value [Lumineau et al. 2015, Goldsby and Hanisch 2022]. These challenges can cause conflicts and introduce opportunistic behavior, which delay or hinder its outcomes.

In addition, inter-organizational collaboration commonly relies on third-party enforcement to ensure that organizations engage in collaborative efforts

[Lumineau et al. 2015]. The centralized governance approach leads to loss of transparency due to information asymmetry between organizations [Winkler et al. 2023] compromising network-level goals if business partners do not see interactions and coordinated efforts as a legitimate way of conducting business [Wegner et al. 2022, Provan and Kenis 2007].

Conversely, blockchain emerges as a distributed-ledger technology that enables secure decentralized transactions among several parties. Trust in the blockchain system is established due to the decentralized consensus mechanism, data immutability, and transparency of transaction records [Li et al. 2020a]. Its taxonomy features enterprise blockchains across many industries, including the automobile, energy, food, and health care [Goldsby and Hanisch 2022].

The use of blockchain to enhance trust management in business settings has been previously investigated in the literature, with the use of reputation systems based on scores [Große et al. 2024, Alemany et al. 2023, Pal et al. 2021]. However, these authors do not investigate a token-based reputation system that links the stakeholders' tokens with their contribution to the blockchain network and their organizational reputation. Additionally, the authors do not address how blockchain-based reputation systems can enhance inter-organizational trust for business collaborations in industry networks. This study focuses on answering the following research questions (RQ):

RQ1: How can inter-organizational trust in business collaborations be managed in a decentralized manner?

RQ2: How can blockchain's transparency and smart contracts support business partnership formation by enhancing trust and automating agreements?

For this purpose, we propose a blockchain-based reputation system for trust management in business collaborations built on tokenization and smart contracts. Particularly, we address the issue of choosing appropriate partners for multi-stakeholder production to enhance trustful collaboration without third parties or intermediaries. Furthermore, we evaluate the feasibility of our proof-of-concept solution on two EVM-based blockchains with different consensus protocols, focusing on execution times and transaction costs. This work has the following contributions:

- A blockchain-based reputation system relying on tokenization and smart contracts for the development of trustworthy relationships in business collaborations without any trusted intermediary or a third party;
- A decentralized system relying on smart contracts to provide business partnership formation for multi-stakeholder production.

This study is organized as follows: Section 2 provides background on trust management in inter-organizational collaboration, blockchain technology, and smart contracts. Section 3 reviews related works. In section 4, we present our proposed blockchain-based reputation system. We also provide an evaluation of the proof-of-concept. Section 5 discusses the applicability of the solution in other existing use cases and its response to the research questions. Section 6 concludes the study and suggests future research directions.

2. Background

This section provides a background on trust management in inter-organizational collaboration, highlighting multi-stakeholder production. It also introduces blockchain and smart contracts as technologies that enhance trust within these collaborative settings.

2.1. Trust Management in Inter-organizational Collaboration

Legally independent organizations may voluntarily organize themselves in network arrangements to exchange information, technology, capital, or assets aiming to achieve common goals [Ganeshu et al. 2024, Ramezani and Camarinha-Matos 2020], such as increasing their competitiveness through combining complementary capabilities for multi-stakeholder production [Kostić and Sedej 2021]. In this setting, collaborative agreements are established between stakeholders.

Selecting appropriate business partners involves creating a pool of organizations with the required capabilities for multi-stakeholder production and an interest in collaboration. In this sense, it involves information sharing between companies to enable searching, evaluation, and ultimately, selection of a transaction partner [Kostić and Sedej 2021].

As shown in Figure 1, in established network-based organizations, the distribution of trust relations among organizations vary [Provan and Kenis 2007], reflecting the different types of bonds among partners (e.g., administrative or technical bonds), as well as their social, institutional, cognitive, technological, and organizational proximity [Klimas et al. 2023]. This aspect may impose restrictions on business partnership formation.

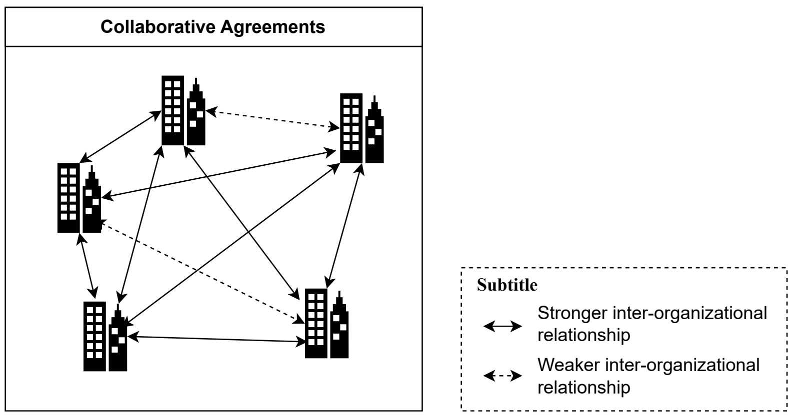

Figure 1. Network-based relationships in inter-organizational collaboration.

In this scenario, we define inter-organizational trust as the subjective belief and prediction that business partners intend to meet their obligations [Chen et al. 2014]. Therefore, trust management is a key determinant of inter-organizational collaboration [Schaffers 2018]. Simultaneously, network governance is central to coordinating collaborative agreements and supportive action leading to business success [Goldsby and Hanisch 2022]. As a result, two main network governance modes have emerged: i) centralized and ii) shared.

Centralized governance relies on a third party or an intermediary authority to manage inter-organizational trust by decreasing direct organization-to-organization interactions [Ganeshu et al. 2024]. Conversely, shared governance allows for collective management and self-governing collaborative efforts [Bridoux and Stoelhorst 2022].

However, both governance modes have their limitations: while centralized governance causes loss of transparency due to information asymmetry [Winkler et al. 2023] and has single points of failure, shared governance suffers from administrative inefficiencies due to a lack of coordination in achieving consensus through negotiation [Wegner et al. 2022]. In this work, governance refers to the ability of organizations to establish business partnerships without the need for a third-party intermediary or centralized architecture.

2.2. Blockchain and Smart Contracts

Blockchain is a decentralized database in which transactions among several parties are permanently recorded in an append-only structure in a peer-to-peer network following a consensus protocol [Li et al. 2020a, Gad et al. 2022]. Blockchain consensus protocol describes how the network nodes - any device able to connect with the network - agree on the validity of a transaction before it can be recorded.

Blockchain utilizes public key cryptography to secure information propagation against data adulteration and non-repudiation [Fang et al. 2020]. In addition, blockchain has permissioned and permissionless settings [Islam et al. 2023]. Permissioned blockchains require explicit permission for consensus node inclusion, while permissionless blockchains do not require specific authorization.

Blockchain systems also enable token implementation - digital units representing various digital assets. Essentially, these tokens can serve as an organization's tool to self-govern their business model and encourage coordination among different actors in a regulated ecosystem, all working towards achieving a common objective [Hülsemann and Tumasjan 2019, Chen 2018, Freni et al. 2022].

Moreover, smart contracts are self-executing agreements controlled by programming codes under specific conditions. In enterprise blockchains, smart contracts enable the automated execution of business processes and secure transactions among organizations based on business rules [Chen et al. 2023, Li et al. 2020b]. Particularly, this work employs an agnostic system for business partnership formation, meaning it can be implemented using smart contracts on permissioned and permissionless blockchains.

Some of the main advantages of blockchain technology for trust management in business collaborations include transparency, immutability, and traceability of transaction records, which can help address issues related to information asymmetry and coordination among stakeholders [Winkler et al. 2023, Kostić and Sedej 2021]. In addition, blockchain can provide a secure and decentralized environment for organizations to interact without reliance on a single controlling entity [Kostić and Sedej 2021].

3. Related Works

Some authors have proposed conceptual frameworks or explored conceptually blockchain-based solutions for trust management in business environments. For instance, [Chen et al. 2023] conducted two case studies of eastern banks to present a high-level conceptual framework with empirical evidence highlighting blockchain's public key cryptography, distributed ledger, consensus mechanism, and smart contracts to improve inter-organizational trust.

Similarly, [Mukhametov 2020] reviewed the problem of self-organizing network communities through reputation systems, acknowledging that providing information/calculations and user participation are two main aspects of reputation systems. [Conway and Garimella 2020] highlighted that the elements of trust in people/organizations include verified identity, reputation, and history of interactions. Moreover, [Große et al. 2024] proposed design principles for blockchain-based capacity exchange platforms, including identity verification, incentive mechanisms, information screening, and reputation building.

In contrast, some proof-of-concept solutions have been proposed in the literature. For example, [Alemany et al. 2023] presented a blockchain-based model to compute the reputation of the stakeholders from a transport network based on scores to optimize resource management. [Qi et al. 2022] explored a blockchain-aided secure reputation system for an e-commerce platform focusing on feedback anonymity and authenticity through cryptographic tokens. Moreover, [Pal et al. 2021] provided a blockchain-based system to implement different trust metrics while allowing a common set of trust evidence.

[Doğan and Karacan 2023] used verifiable credentials for identity management and tokens for authenticity feedback and incentives. The tokens were necessary for a buyer to submit feedback about sellers and could be redeemed for discounts or other benefits on the buyer's future purchases within an e-commerce platform.

However, none of the presented works used a token-based reputation system to foster inter-organizational trust, in which tokens held by stakeholders represent their reputation, and token rewards are used as an incentive mechanism to increase the organization's reputation in the network based on its contribution. In particular, none of the presented works explore how smart contracts can automate stakeholders' token incentives and competencies while providing partnership formation in business collaborations. Table 1 summarizes related work and the proposed study.

Table 1. Related works and the proposed study.

References	Blockchain-based	Token-based reputation	Token-based incentive	Decentralized partnership formation
[Große et al. 2024]	●	○	○	●
[Alemany et al. 2023]	●	○	○	●
[Mukhametov 2020]	●	○	○	○
[Conway and Garimella 2020]	●	○	○	○
[Chen et al. 2023]	●	○	○	○
[Qi et al. 2022]	●	○	●	○
[Doğan and Karacan 2023]	●	●	●	○
[Pal et al. 2021]	●	○	○	●
This work	●	●	●	●

4. Proposed Blockchain-based Reputation System

Figure 2 illustrates an overview of the proposed blockchain-based reputation system. Organizations represent the stakeholders - nodes - in the blockchain. Each stakeholder has a number of tokens in their digital wallet based on their contribution to the system. In this sense, there is a direct correlation with the stakeholder's reputation, i.e., a greater number of tokens represents a greater reputation.

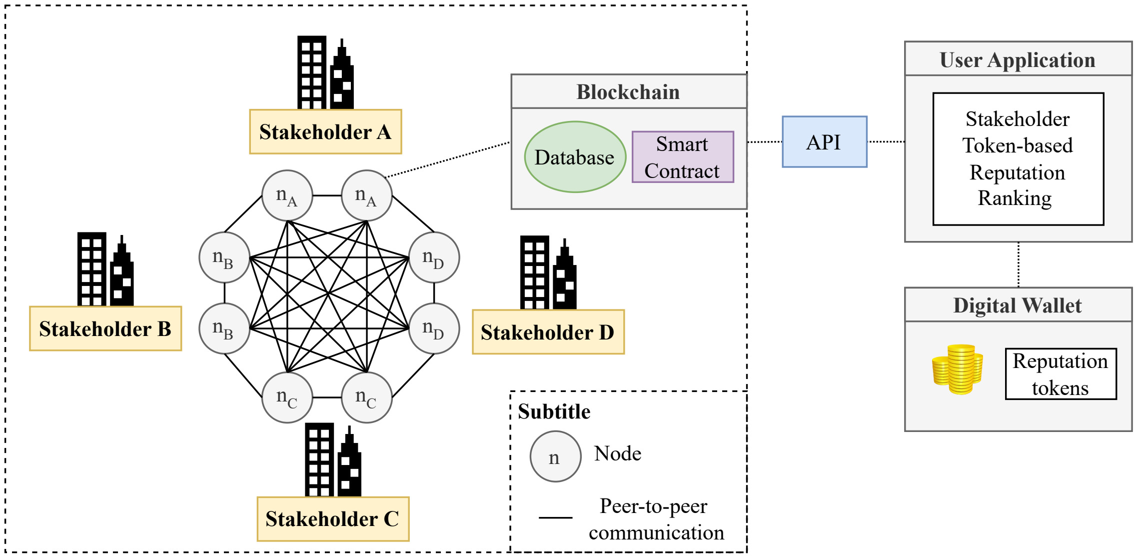

Figure 2. An overview of the proposed blockchain-based reputation system for business collaborations.

Note that reputation tokens do not have real monetary value in our context. However, partnership formation represents a business opportunity for multi-stakeholder production. In this sense, this approach is consistent with previous literature that highlights that blockchain nodes can be motivated to behave cooperatively to keep their reputation tokens at a high level, encouraged by rational and indirect profit-driven incentives [Han et al. 2022].

The contribution to the ecosystem is related to two main aspects: i) an organization sharing information about its profile and competencies, and ii) an organization attesting that a business partner successfully provided a complementary competency. Therefore, we address competence-based trust, which is related to the expectation that a business partner has the required technical skills, experience, and reliability to fulfill specified obligations [Chen et al. 2023]. In addition, the tokenization process creates a self-governed tokenomic system with rules to align stakeholders' behavior with the business' goal [Freni et al. 2022].

4.1. Proposed Workflow

The entire logic of the token-based reputation system is embedded in a single smart contract. When stakeholders want to select a business partner for multi-stakeholder production, they interact with the smart contract through a user application that communicates with the blockchain environment through an application programming interface (API). Figure 3 illustrates the proposed workflow that can be divided into the following phases:

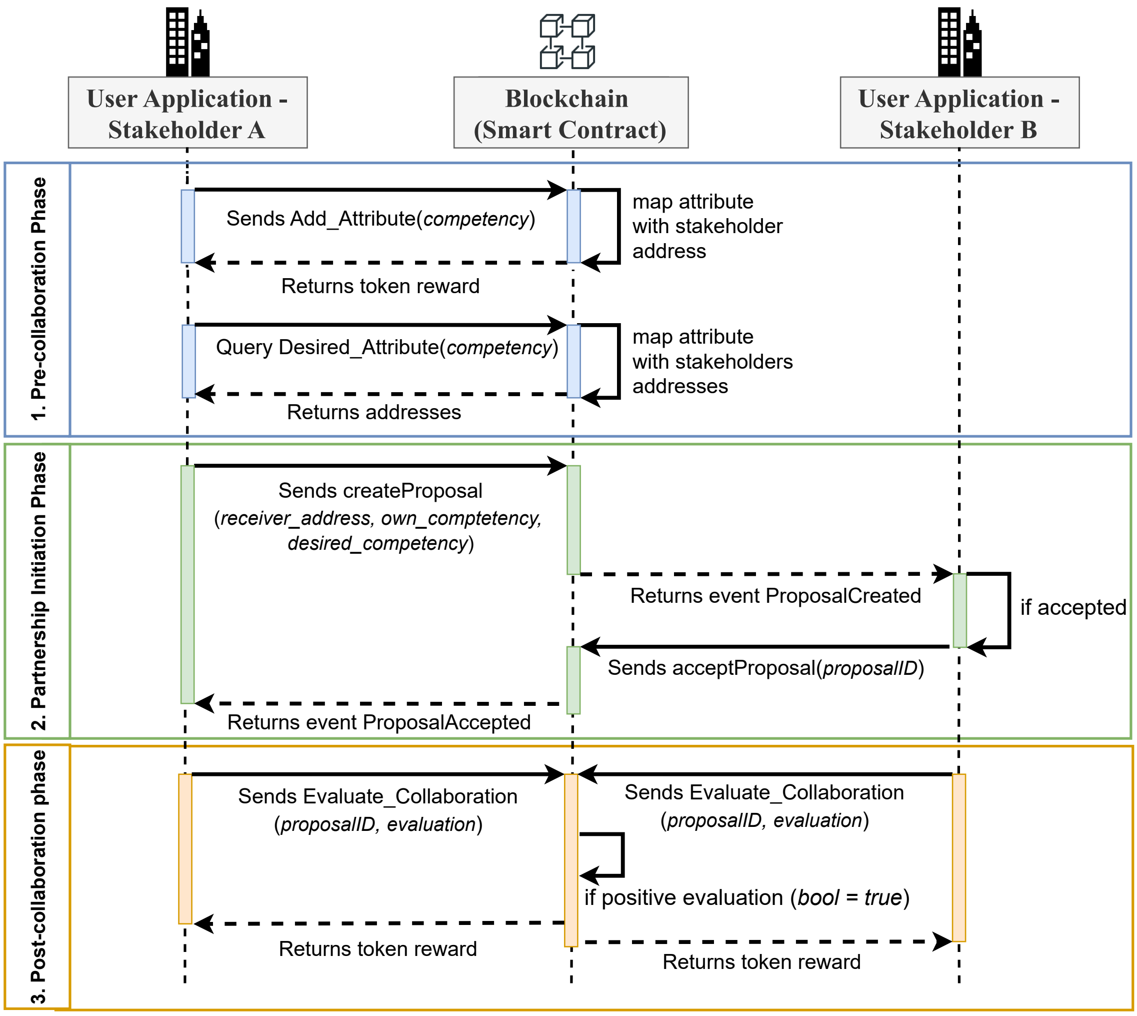

Figure 3. Workflow in the blockchain-based reputation system. Stakeholders interact with the smart contract through a user application to select business partners for multi-stakeholder production.

1. **Pre-collaboration phase**: organizations can send transactions containing their attributes - competency or profile data - to the smart contract in return for a token reward. This allows them to share information that enables other stakeholders to propose business partnerships based on their complementary competencies. When a stakeholder A is interested in finding a partner for multi-stakeholder production, it can send a query to the smart contract containing the desired partner's attribute. In response, the smart contract returns a list with the addresses of the stakeholders that match the query. The user application can order the addresses of the stakeholders based on their token-based reputation to support partner selection (as illustrated in Figure 2).
2. **Partnership initiation phase**: if stakeholder A is interested in collaborating with stakeholder B, it can send a transaction to create a proposal for partnership. Stakeholder B is notified of the pending proposal by an event. If stakeholder B accepts the proposal, a business collaboration for multi-stakeholder production is successfully established.
3. **Post-collaboration phase**: after the establishment and operation of the multi-

stakeholder production, organizations can evaluate each other's complementary attributes based on their partnership performance. If stakeholder A is satisfied with the performance of stakeholder B's attribute, stakeholder B is rewarded with tokens. Note that proposals between stakeholders are sent, accepted, and evaluated through the smart contract in the blockchain system, which ensures transparent and immutable transaction records for all organizations involved. In this sense, blockchain transparency can help address issues related to information asymmetry and coordination, as stakeholders can make more informed decisions about business partnerships and coordinate activities more effectively based on proposal records.

4.2. Threat Analysis for Stakeholders' Reputation

This section presents potential threats regarding the blockchain-based reputation system as follows:

- **False attribute (Threat 1):** organizations could submit false attributes (competency or profile data) to the blockchain to collect token rewards and increase their token-based reputation. However, we argue that this situation can be overcome since all organizations on the blockchain network have transparent access to the relationship between the number of proposals accepted for a given attribute and the number of positive evaluations for it. In this sense, false attributes would be easily identified, and sanctions could be applied to malicious nodes. In the future, we intend to explore in more detail the quality of data published on the blockchain.
- **Token exchange (Threat 2):** an organization could receive tokens from another in our system to increase its reputation through purchasing tokens. This could be detrimental to the fairness and accuracy of the reputation system. However, we argue that blockchain's transparency would highly discourage this process, as transactions between nodes would be recorded, and sanctions could also be applied to transgressors.
- **False evaluation (Threat 3):** organizations could submit false evaluations about a partner's attribute to the blockchain to manipulate their token-based reputation. However, we argue that as business collaboration in the use case is profit-oriented (through multi-stakeholder production), it is not in the organizations' interest to artificially increase the reputation of partners whose attributes do not meet the specified obligations. In the case in which organizations attempt to artificially lower the reputation of partners who have met specified obligations, we argue that blockchain transparency supports identifying false evaluations and applying sanctions.

Note that sanctions in our context could comprise off-chain governance mechanisms (through legally binding punishments applied to the organizations) or on-chain sanction policies such as withdrawing reputation tokens from the transgressor. Furthermore, we assume that the majority of the network is honest and there is no interest in collusion between organizations to act maliciously in the use case. Further discussions about this topic are out of the scope of this study.

4.3. Proof-of-Concept Implementation and evaluation

This section presents the feasibility evaluation of our proof-of-concept solution. We use a local machine with an Ubuntu 23.10 operating system, an Intel Core i7-10510U @ 8x

4.9GHz CPU, and 16GB RAM.

Although enterprise blockchains are commonly implemented in permissioned settings [Petersen 2022], in this work, we evaluate the proposed solution in the Hyperledger Besu platform, using a Byzantine Fault Tolerance-based (BFT) protocol, in addition to the Sepolia test network, using the Proof-of-Stake protocol. This approach is used to explore the applicability of the blockchain-based reputation system in EVM-based permissioned and permissionless blockchains. In addition, we focus on evaluating execution times and transaction costs of the smart contract's functions. We plan to evaluate the tokenomics of our solution in future studies.

Figures 4 and 5 illustrate the distribution of execution times for the main functions in our smart contract, as illustrated in Figure 3. We conducted 500 executions for each function using Hyperledger Besu and Sepolia networks. Our results for Sepolia indicate small data variability. The average execution times for each function are similar, ranging from 12.14 to 12.41 seconds. The resulting execution times are due to a high number of transaction calls and consensus communication delays in public blockchains.

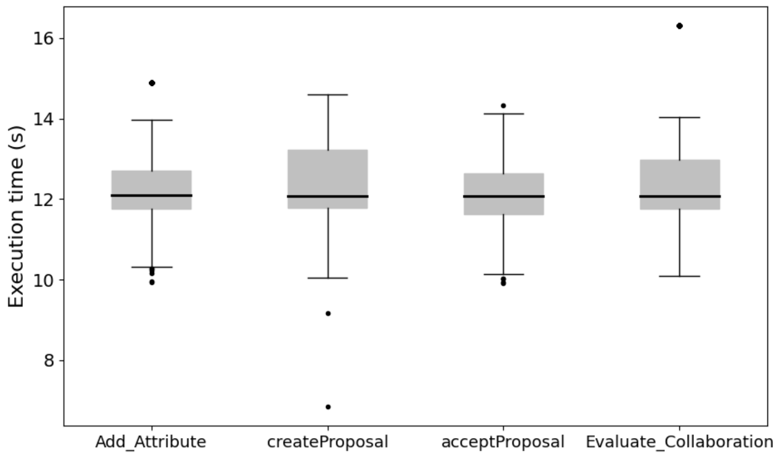

Figure 4. Execution time for the main smart contract functions in 500 iterations using the Sepolia test network.

Our results for Hyperledger Besu also show small data variability. The average execution times for each function are similar, ranging from 4.12 to 5.04 seconds. The low execution times are due to the minimum consensus communication delay in the local network, which consists of four consensus nodes.

In addition, the distribution of execution times indicates that typical values remain under 15 seconds for both evaluations (permissionless and permissioned). We argue that this result is adequate for our blockchain-based reputation system as creating and accepting proposals means establishing business partnerships for multi-stakeholder production, which requires a relatively long time span.

Table 2 compares the transaction gas cost for the main functions in the smart contract. By default, permissioned networks have no gas costs associated with sending transactions. Therefore we consider the price of the gas consumed in Hyperledger Besu

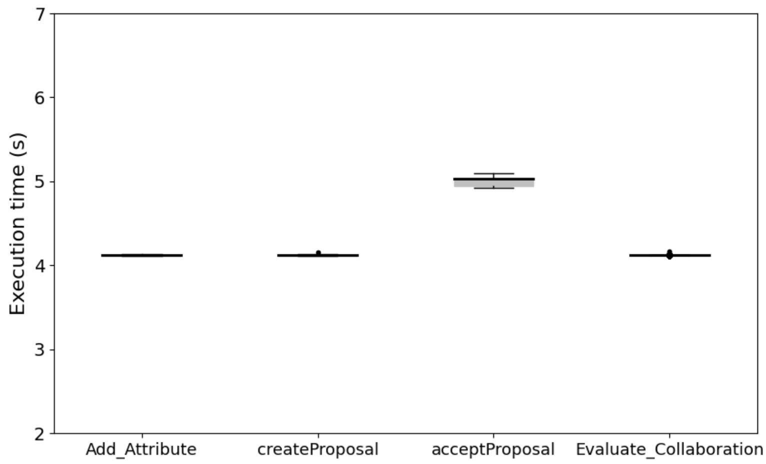

Figure 5. Execution time for the main smart contract functions in 500 iterations using the Hyperledger Besu platform with four consensus nodes.

as zero. In the Sepolia network, we conducted 500 executions for each function and collected the average (Avg.) and standard deviation (Std.) of the gas cost in ether and the approximated value in dollars. The results show adequate gas costs associated with transactions for all functions in the smart contract, with low standard deviations.

Table 2. Gas cost of the main functions in the smart contract for 500 executions.

Function	Permissioned Network (*ETH/USD*)	Permissionless Network			
		Avg. (*ETH*)	Std. (*ETH*)	$\approx Avg.(USD)$	$\approx Std.(USD)$
Add_Attribute	0	0.000027	0.000005	0.09	0.02
createProposal	0	0.000213	0.000111	0.71	0.37
acceptProposal	0	0.000095	0.000143	0.31	0.47
Evaluate_ Collaboration	0	0.000047	0.000099	0.16	0.33

5. Discussion

This section presents how the proposed solution addresses the research questions presented in Section 1, as discussed below.

- *RQ1: How can inter-organizational trust in business collaborations be managed in a decentralized manner?*
  The proposed blockchain-based reputation system relies on tokenization and smart contracts to foster trust among stakeholders by offering a transparent and decentralized means of quantifying and monitoring their contributions in the blockchain. Stakeholder contributions include information sharing— a key element in inter-organizational collaboration— and assessing partners' reliability to fulfill specified obligations (competency). In this sense, the proposed system enhances inter-organizational trust in a decentralized manner.

- *RQ2: How can blockchain's transparency and smart contracts support business partnership formation by enhancing trust and automating agreements?*
  The proposed solution enables multi-stakeholder production by providing access to business partners. Organizations in the blockchain system share competency/profile data, sending transactions to the smart contract to receive token rewards, which facilitate partner identification based on complementary attributes. Stakeholders can query the smart contract to find suitable partners, leveraging blockchain transparency. In the process, reputation tokens are associated with a stakeholder's likelihood of becoming a business partner, i.e., the more reputation tokens a stakeholder has, the greater their chances of being chosen for business partnership. Partnership proposals are created and accepted via transactions, and stakeholders evaluate each other's performance, fostering trust and collaboration.

Moreover, the proposed solution is feasible in permissioned and permissionless blockchains, expanding its applicability for trust management between public or private entities in contexts other than business.

The proposed blockchain-based reputation system for business collaborations may also provide valuable feedback about stakeholders' reputations aligned with core competencies to support business strategy in partner selection [Franco and Haase 2020, Esmaelnezhad et al. 2023] and in production planning and control [Tiwari et al. 2024] to deliver multi-stakeholder production. Particularly in this use case, as information sharing that enables partnership formation may involve exchanging sensitive organizational data, permissioned blockchains emerge as a preferable solution. In the future, we intend to explore data privacy in our system in more detail.

In addition, as reported in the literature [Afsarmanesh and Camarinha-Matos 2009], the size of networks of customers, partners, and suppliers (i.e., the quantity of organizations collaborating in industry networks) varies significantly, according to the application, from less than 20 to up to 1000. We argue that as the network size increases, coordination and trust management at a network level become increasingly complex, and our solution becomes more relevant.

Simultaneously, increasing the number of validator nodes in the blockchain network raises the complexity of exchanging consensus messages. In particular, for the Hyperledger Besu (BFT-based consensus), the network operates without performance loss with up to 30 validator nodes [Garcia et al. 2022]. However, we argue that our systems could afford some performance loss as real-time is not a strong requirement for the business partnership formation use case.

6. Conclusion

Trust management is crucial for the collaborative success of multi-stakeholder production in industry networks. However, challenges such as lack of information transparency, coordination issues, and incentive misalignment can lead to mistrust among stakeholders.

In this work, we introduced a proof-of-concept for a blockchain-based reputation system. The proposed solution, tailored for the business collaboration use case, links the blockchain node's tokens with their contribution to the network and their organizational reputation, supporting business partnership formation through smart contracts and tokenization over a decentralized infrastructure. Our evaluation shows the feasibility of our solution in permissionless and permissioned EVM-based blockchains.

This research contributes to understanding how blockchain mechanisms impact trust management applications. Despite dealing with a use case in the private domain, our solution applies to several collaborative multi-stakeholder settings. Future studies may address data quality and privacy concerns in competency-based trust management of industrial networks.

References

Afsarmanesh, H. and Camarinha-Matos, L. M. (2009). On the classification and management of virtual organisation breeding environments. *Int. J. Inf. Technol. Manage.*, 8(3):234–259.

Alemany, P., Munoz, R., Martrat, J., Pastor, A., Diaz, R., Lopez, D., Casellas, R., Martinez, R., and Vilalta, R. (2023). Blockchain-based trust management collaborative system for transport multi-stakeholder scenarios. *Journal of Optical Communications and Networking*, 15(8):488–496.

Bridoux, F. and Stoelhorst, J. W. (2022). Stakeholder governance: Solving the collective action problems in joint value creation. *Academy of Management Review*, 47(2):214–236.

Chen, R. R., Chen, K., and Ou, C. X. (2023). Facilitating interorganizational trust in strategic alliances by leveraging blockchain-based systems: Case studies of two eastern banks. *International Journal of Information Management*, 68:102521.

Chen, Y. (2018). Blockchain tokens and the potential democratization of entrepreneurship and innovation. *Business Horizons*, 61(4):567–575.

Chen, Y.-H., Lin, T.-P., and Yen, D. C. (2014). How to facilitate inter-organizational knowledge sharing: The impact of trust. *Information & Management*, 51(5):568–578.

Conway, D. and Garimella, K. (2020). Enhancing trust in business ecosystems with blockchain technology. *IEEE Engineering Management Review*, 48(1):24–30.

Doğan, O. and Karacan, H. (2023). A blockchain-based e-commerce reputation system built with verifiable credentials. *IEEE Access*, 11:47080–47097.

Esmaelnezhad, D., Taghizadeh-Yazdi, M., Amoozad Mahdiraji, H., and Vrontis, D. (2023). International strategic alliances for collaborative product innovation: An agent-based scenario analysis in biopharmaceutical industry. *Journal of Business Research*, 158:113663.

Fang, W., Chen, W., Zhang, W., Pei, J., Gao, W., and Wang, G. (2020). Digital signature scheme for information non-repudiation in blockchain: a state of the art review. *EURASIP Journal on Wireless Communications and Networking*, 2020(1).

Franco, M. and Haase, H. (2020). The role of reputation in the business cooperation process: multiple case studies in small and medium-sized enterprises. *Journal of Strategy and Management*, 14(1):82–95.

Freni, P., Ferro, E., and Moncada, R. (2022). Tokenomics and blockchain tokens: A design-oriented morphological framework. *Blockchain: Research and Applications*, 3(1):100069.

Gad, A. G., Mosa, D. T., Abualigah, L., and Abohany, A. A. (2022). Emerging trends in blockchain technology and applications: A review and outlook. *Journal of King Saud University - Computer and Information Sciences*, 34(9):6719–6742.

Ganeshu, P., Fernando, T., Therrien, M.-C., and Keraminiyage, K. (2024). Inter-organisational collaboration structures and features to facilitate stakeholder collaboration. *Administrative Sciences*, 14(2).

Garcia, R. D., Ramachandran, G. S., Jurdak, R., and Ueyama, J. (2022). Blockchain-aided and privacy-preserving data governance in multi-stakeholder applications. *IEEE Transactions on Network and Service Management*, 19(4):3781–3793.

Goldsby, C. and Hanisch, M. (2022). The boon and bane of blockchain: Getting the governance right. *California Management Review*, 64(3):141–168.

Große, N., Möller, F., Schoormann, T., and Henke, M. (2024). Designing trust-enabling blockchain systems for the inter-organizational exchange of capacity. *Decision Support Systems*, 179:114182.

Han, R., Yan, Z., Liang, X., and Yang, L. T. (2022). How can incentive mechanisms and blockchain benefit with each other? a survey. *ACM Comput. Surv.*, 55(7).

Hülsemann, P. and Tumasjan, A. (2019). Walk this way! incentive structures of different token designs for blockchain-based applications. In *International Conference on Interaction Sciences*.

Islam, S., Islam, M. J., Hossain, M., Noor, S., Kwak, K.-S., and Islam, S. M. R. (2023). A survey on consensus algorithms in blockchain-based applications: Architecture, taxonomy, and operational issues. *IEEE Access*, 11:39066–39082.

Klimas, P., Stańczyk, S., Sachpazidu, K., Stanimir, A., and Kuźmiński, (2023). The attributes of inter-organizational relationships: Which fifteen of them really matter to software developers? *Industrial Marketing Management*, 110:1–16.

Kostić, N. and Sedej, T. (2021). Blockchain technology, inter-organizational relationships, and management accounting: A synthesis and a research agenda. *Accounting Horizons*, 36(2):123–141.

Li, D., Wong, W. E., and Guo, J. (2020a). A survey on blockchain for enterprise using hyperledger fabric and composer. In *2019 6th International Conference on Dependable Systems and Their Applications (DSA)*. IEEE.

Li, X., Jiang, P., Chen, T., Wang, L., and Wen, Q. (2020b). A survey on the security of blockchain systems. *Future Generation Computer Systems*, 107:841–853.

Lumineau, F., Eckerd, S., and Handley, S. (2015). Inter-organizational conflicts: Research overview, challenges, and opportunities. *Journal of Strategic Contracting and Negotiation*, 1(1):42–64.

Mukhametov, D. R. (2020). Self-organization of network communities via blockchain technology: Reputation systems and limits of digital democracy. In *2020 Systems* *of Signal Synchronization, Generating and Processing in Telecommunications (SYNCHROINFO)*, pages 1–7.

Pal, S., Hill, A., Rabehaja, T., and Hitchens, M. (2021). A blockchain-based trust management framework with verifiable interactions. *Computer Networks*, 200:108506.

Petersen, D. (2022). Automating governance: Blockchain delivered governance for business networks. *Industrial Marketing Management*, 102:177–189.

Provan, K. G. and Kenis, P. (2007). Modes of Network Governance: Structure, Management, and Effectiveness. *Journal of Public Administration Research and Theory*, 18(2):229–252.

Qi, S., Li, Y., Wei, W., Li, Q., Qiao, K., and Qi, Y. (2022). Truth: A blockchain-aided secure reputation system with genuine feedbacks. *IEEE Transactions on Engineering Management*, pages 1–15.

Ramezani, J. and Camarinha-Matos, L. M. (2020). Approaches for resilience and antifragility in collaborative business ecosystems. *Technological Forecasting and Social Change*, 151:119846.

Schaffers, H. (2018). The relevance of blockchain for collaborative networked organizations. In *Collaborative Networks of Cognitive Systems*, page 3–17. Springer International Publishing.

Tiwari, M. K., Bidanda, B., Geunes, J., Fernandes, K., and Dolgui, A. (2024). Supply chain digitisation and management. *International Journal of Production Research*, 62(8):2918–2926.

Wegner, D., Dias, M. F. P., Azevedo, A. C., and Marconatto, D. A. B. (2022). Configuring the governance and management of strategic networks for higher performance. *Journal of Business & Industrial Marketing*, 37(12):2501–2514.

Winkler, M., Wegner, D., and Macagnan, C. B. (2023). The maturity of strategic networks&amp rsquo; governance: Proposal of an analysis model. *Administrative Sciences*, 13(5).