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From ERP to Ethereum: Process Mining Reimagined

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Abstract

Integrating blockchain technology with process mining has emerged as a promising approach to enhance data transparency, security, and integrity in organizational operations. This study compares traditional and blockchain-based process mining methods through a case study in the food supply chain sector. Employing the design science research methodology, we developed and implemented a smart contract on the ethereum platform to automate the goods requisition process. Event logs were collected from a traditional Enterprise Resource Planning (ERP) system and the blockchain environment for comparative analysis. The results demonstrated a higher conformance rate between the blockchain-based process model and the theoretical baseline (85%) than the traditional approach (74%). These findings suggest that blockchain's inherent features-immutability, decentralization, and auditability-significantly improve process accuracy and data reliability. This work contributes to the growing field of blockchain-enabled business process management and highlights its potential to transform data-driven decision-making in complex supply chain networks.

Keywords: Process mining, Blockchain, Smart contract, Food supply chain, Design science research.

1 | Introduction

Business process management has long relied on enterprise information systems such as Workflow Management (WFM), Enterprise Resource Planning (ERP), Enterprise Application Integration (EAI), and Web Services (WS) are traditionally employed to automate and manage business processes. While these systems effectively support process execution, they often lack capabilities for monitoring and analyzing operational behavior in real-time [1]. In response to this limitation, process mining has emerged as a robust technique that enables the discovery, conformance checking, and enhancement of business processes by extracting insights from event logs generated during system execution [2], [3].

Simultaneously, blockchain technology has garnered increasing interest for its potential to enhance data integrity, security, and traceability across decentralized environments [4]. Initially introduced for cryptocurrency applications, blockchain offers unique features such as immutability, transparency, and

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auditability that make it applicable beyond finance, notably in sectors such as supply chain management, healthcare, and manufacturing [5].

The intersection of these two technologies-process mining and blockchain-offers a novel opportunity to enhance the reliability and verifiability of process data by leveraging blockchain's tamper-resistant infrastructure. This integration addresses one of the key challenges in traditional process mining: The dependency on centralized systems where data can be altered, deleted, or lost, thus compromising the accuracy of process analysis [6].

Research on applying blockchain in supply chain contexts has grown rapidly in recent years, highlighting its potential to increase visibility, reduce fraud, and improve collaboration, as illustrated in *Fig. 1*. However, empirical studies still lack assessing how blockchain-based logging compares with traditional methods in process mining outcomes, particularly in real-world scenarios such as food supply chains [7].

This study seeks to fill that gap by proposing and evaluating a blockchain-enabled process mining approach. We implement a smart contract on the Ethereum platform to automate a core process-goods requisition-in a food supply chain. Using the Design Science Research (DSR) methodology, we develop, test, and evaluate the proposed solution by comparing its performance against traditional process mining techniques.

The remainder of the paper is structured as follows: Section 2 reviews related literature on process mining, blockchain, and smart contracts. Section 3 outlines the research design and implementation methodology. Section 4 presents the analysis and results. Section 5 discusses the implications, and Section 6 concludes with suggestions for future research directions.

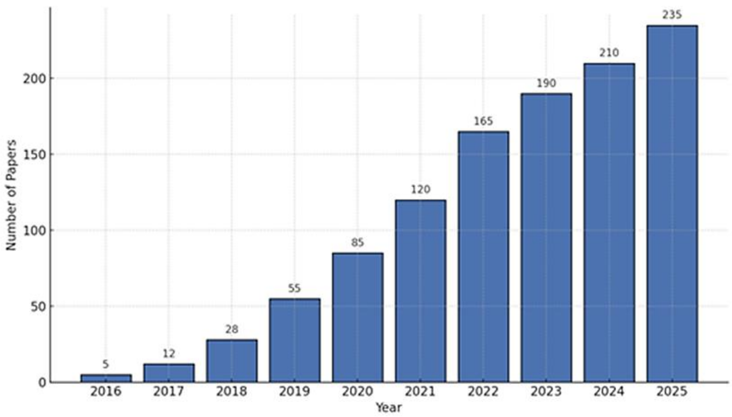

Fig. 1. Number of publications on the application of blockchain in supply chain (2016-2025).

2 | Literature Review

In recent years, integrating emerging technologies into business process analysis has attracted significant attention in academia and industry. This section reviews the evolution of three interrelated domains-process mining, blockchain, and smart contracts-focusing on their application in supply chain management. We also highlight the limitations of prior work and identify gaps that motivate the current research.

Process mining is a powerful discipline that bridges data science and business process management. Initially conceptualized by Van Der Aalst et al. [1], [8], [9] process mining focuses on extracting knowledge from event logs generated by information systems to discover process models, check conformance with theoretical models, and suggest enhancements to improve performance.

The strength of process mining lies in its ability to analyze real-time process executions rather than relying solely on theoretical models. This has enabled organizations to uncover hidden bottlenecks, performance inefficiencies, and process deviations [10]–[12]. However, the effectiveness of process mining depends heavily on the quality and reliability of event logs, which remain a critical challenge in conventional centralized systems. Event logs are often incomplete, manipulated, or inconsistently recorded, making downstream analysis error-prone [9].

To overcome these data reliability issues, researchers have begun exploring blockchain technology as a potential solution. Blockchain provides a decentralized and immutable infrastructure for recording transactional data across distributed nodes. Each block in the chain is cryptographically secured and chronologically ordered, ensuring that stored data cannot be altered retroactively [13], [14].

In the supply chain domain, blockchain has shown considerable promise in improving traceability, auditability, and stakeholder trust. The researchers in [5], [6] have emphasized blockchain's potential to eliminate fraud and manipulation by enabling secure tracking of goods across multiple supply chain entities. Lorenz-Meyer [15] showed how blockchain-based tracking systems reduce tracking times from days to minutes, significantly enhancing responsiveness during food safety crises [16].

Despite these promising results, many blockchain applications in supply chains have remained conceptual or prototype-based, lacking integration with advanced analytical frameworks such as process mining. In addition, scalability concerns, high energy consumption, and data privacy limitations hinder large-scale adoption [17]. *Table 1* demonstrates the features of blockchain and limited types of distributed database systems.

Smart contracts extend blockchain's capabilities by enabling the execution of self-enforcing agreements without intermediaries. Introduced as part of Ethereum's architecture, smart contracts are now widely used to automate transactional logic and enforce business rules transparently [18], [19].

Researchers have proposed using smart contracts to automate procurement, compliance, and asset-tracking processes [20]. However, integrating smart contracts with data analysis frameworks especially process mining- has not been widely explored in empirical research. Furthermore, security remains a concern: Puneeth and Parthasarathy [21] proposed lightweight encryption schemes like Intuitionistic Derivative Symmetrical Encryption (IDSE) to enhance confidentiality and reduce cryptographic overhead. However, such approaches are rarely incorporated into holistic business process solutions.

The review reveals a fragmented landscape where process mining and blockchain are often treated as separate research streams. While process mining excels at diagnosing process inefficiencies, it relies on data vulnerable to manipulation. Conversely, blockchain ensures secure data storage but lacks analytical capabilities for interpreting process behavior.

Vazquez Melendez et al. [22] examine the blockchain landscape in supply chain management by drawing insights from academic and industry literature. It identifies the key drivers, categorizes the products involved, and highlights the business values achieved by early adopters of blockchain technology within the supply chain domain. Additionally, it explores fingerprinting techniques to establish a robust connection between physical products and the blockchain ledger.

The authors combined the interpretive sensemaking systematic literature review with offering insights into how organizations interpreted their business challenges and adopted blockchain technology in their specific supply chain context; content analysis (Using Leximancer automated text mining software) for concept mapping visualization, facilitating the identification of key themes, trends, and relationships, and qualitative thematic analysis (NVivo) for data organization, coding and enhancing the depth and efficiency of analysis.

Pattanayak et al. [23] utilize semi-structured interviews with 31 industry experts, followed by thematic analysis, to unveil the underlying mechanisms through which blockchain technology influences supply chain performance. Their findings underscore the pivotal role of trust, facilitated by blockchain technology features, in enhancing supply chain performance, emphasizing the interdependence of trust in technology, platforms, and supply chain members. Moreover, their study uncovers the substantial influence of supply chain uncertainty on the association between blockchain and trust, acknowledging its pertinence in the modern business landscape.

Only a few studies have hinted at the synergistic potential of combining blockchain security with process mining's analytical power [11]. However, these works are theoretical or focus on blockchain applications in isolation, without offering comparative evaluations against traditional mining methods or real-world implementations in critical domains like food supply chains.

This study addresses these gaps by developing and evaluating a blockchain-enabled process mining framework in the context of a real goods requisition process. Unlike prior work, we use a smart contract deployed on the Ethereum platform to generate immutable event logs, which are then analyzed using process mining techniques. This approach allows us to empirically measure the impact of blockchain on process transparency, data quality, and model conformance.

Table 1. Features of blockchain technology.

Features	Public Blockchain	Private Blockchain	Consortium Blockchain	Centralized Database	Distributed Database
Access control	Open to all	Restricted to known entities	Restricted to a selected group	Controlled by admin	Controlled by nodes
Consensus mechanism	Proof of Work (PoW), Proof of Stack (PoS), etc.	Optional / lightweight	Business Fault Tolerance (BFT)	Not applicable	Not applicable
Immutability	High	Medium	Medium–high	Low	Medium
Data transparency	Full	Limited	Partial	Low	Medium
Scalability	Low–medium	High	Medium–high	Very high	High
Transaction speed	Low	High	Medium	Very high	High
Energy consumption	High	Low	Low–medium	Low	Medium
Trust model	Trustless (Via code)	Trust among entities	Shared trust	Full trust in admin	Partial trust
Smart contract support	Yes	Yes	Yes	No	No
Auditability	Strong	Strong	Strong	Medium	Medium
Security level	Very high	High	High	Medium	Medium
Typical use cases	Cryptocurrencies, NFTs	Enterprise apps	Supply chain, banking	Legacy systems	Distributed apps

3 | Methodology

This research adopts the DSR methodology to systematically design, implement, and evaluate a blockchain-based process mining framework. DSR is well-suited for studies aiming to develop innovative artifacts such as algorithms, models, or systems that address real-world problems in a rigorous and repeatable manner [24].

Following DSR principles, the research process is divided into five stages, as illustrated in *Fig. 2*: 1) problem identification, 2) objective definition, 3) artifact design and development, 4) demonstration and evaluation, and 5) reflection and conclusion.

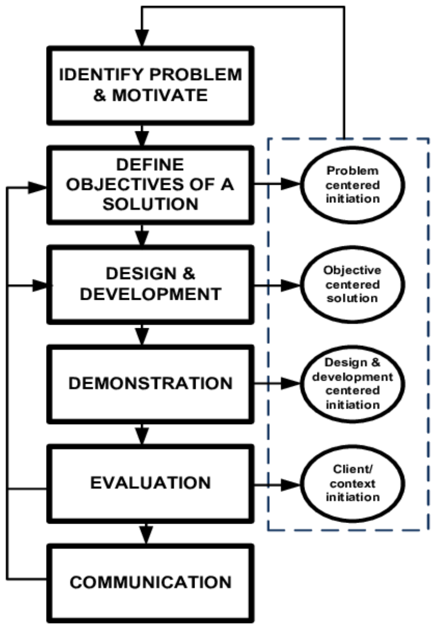

Fig. 2. Design science research methodology steps [24].

Problem identification

Traditional process mining techniques rely on event logs stored in centralized systems such as ERP platforms. These systems often suffer from vulnerabilities, including data tampering, inconsistent logging standards, and limited traceability across organizational boundaries. To address this, we aim to investigate whether blockchain-based logging mechanisms can enhance the quality and reliability of event data used in process mining.

Objective definition

This research aims to design and evaluate a blockchain-enabled smart contract to automate a procurement-related business process in the food supply chain domain. The goal is to compare the output of process mining using traditional ERP logs versus blockchain-logged events in terms of model conformance, accuracy, and transparency.

Artifact design and development

At this stage, the core artifact of the research is introduced: A smart contract designed and implemented on the Ethereum blockchain using the remix IDE. In the context of DSR, an artifact is a purposeful construct that encapsulates innovative knowledge and addresses a real-world problem. Our artifact operationalizes the purchase requisition by encoding logic into a decentralized, tamper-proof system. *Fig. 3* illustrates the business process notation of our study. Moreover, the following pseudo-code outlines the functional structure of the smart contract, which manages the flow of data and decision logic during a goods request scenario within a food supply chain context.

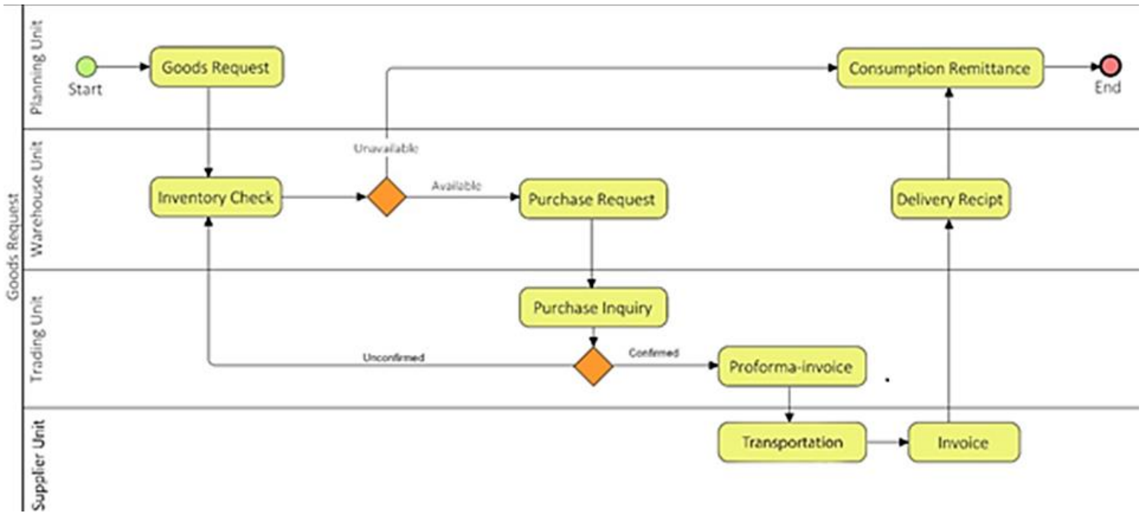

Fig. 3. Theoretical BPMN model.

Algorithm 1. The designed smart contract structure.

1. Initialize contract "goodsrequestcontract"
2. Setup phase:
   2.1. Define blockchain node addresses
   2.2. Define structure for goods:
      - Name
      - Inventory quantity in warehouse
3. Goods request workflow:
   3.1 Function: Request goods()
      - Input: Item name, quantity
      - Check: If item exists in inventory
   3.2 If requested quantity ≤ inventory:
      - Send confirmation: "available"
      - Proceed to issue consumption remittance
   3.3 Else:
      - Send alert: "Insufficient inventory"
      - Trigger purchase request()
4. Function: purchase request()
   4.1. Retrieve request details
   4.2. Identify trading unit address
   4.3. Function: Initiatepurchaseinquiry()
      - Await confirmation from the trading unit
   4.4. If inquiry approved:
      - Generate proforma invoice
      - Send order to supplier
   4.5. Function: Receive order()
      - Validate and update inventory
      - Issue final invoice
5. Complete transaction:
   - Log event
   - Update blockchain state
   - End

Demonstration and evaluation

To demonstrate the artifact's functionality, we applied process mining on two data sets: 1) event logs exported from an ERP system, and 2) logs extracted from the Ethereum smart contract. Using ProM software, conformance checking was performed to evaluate the alignment between each discovered model and the predefined Business Process Model and Notation model (BPMN) process model. The blockchain-based model achieved an 85% fitness score, surpassing the 74% score from traditional ERP-based mining. This demonstrates blockchain's potential to produce higher-fidelity models by preserving data authenticity. *Table 2* illustrates the relationship between hashed data and order status.

Table 2. Mapping of hashed data to corresponding order status.

Feature	Contract	Description
Activity	0x1cd62c7a0031534a87b1001c4fec5a6ee0e…	Request
	0x179408ea831f8e4acf8f1c4fec5e6ee0e30a…	Invoice
	0x78c60b74d3c89c2213a945757b1217a13b…	Send
	0xb253877fc887b133c16d62c7a00e3342f3c…	Delivery
Resource	0xa2f9f5af15501b7c463391d350e0e146cb285	Planning
	0xf36fc02c49638b99d7ce5d0af07b9078c5513	Trading
	0x499ecc48e8f54fa145ad49cfb79efa1b84b8ca	Warehouse
	78cb145e67b99745ae44412b00ee3458e77d83	Supplier
CaseID	00000000000000000002711	100001
	00000000000000000002712	100002
	00000000000000000002713	100003
	00000000000000000002714	100004

Reflection (Communication)

The artifact design, implementation, and evaluation highlight the potential of blockchain as a trusted source of process execution data. While this approach introduces additional complexity and cost, it offers significant gains in traceability and robustness particularly for inter-organizational workflows in sensitive domains such as food supply chains. This reflection sets the stage for broader adoption and cross-domain applications. Process data was extracted from an ERP system and analyzed using traditional process mining techniques as the baseline (Model 1).

In the second phase, after deploying the smart contract on the Ethereum blockchain, the same process was logged and extracted from the blockchain platform to create the blockchain-based model (Model 2). A comparative analysis was then performed to assess how each model aligns with the predefined theoretical process model. This evaluation reflects the artifact's effectiveness in addressing the problem of data reliability and conformance in process mining.

Figs. 3 and *4* illustrate the conformance-checking results generated using the ProM framework, which measures the fitness between each discovered model and the reference model. It is important to note that while the evaluation spans multiple stages of the DSR methodology, the behavioral consistency of the artifact was maintained throughout. This indicates that the results presented are cumulative and reflect a stable implementation across all phases rather than isolated outcomes from a single experiment.

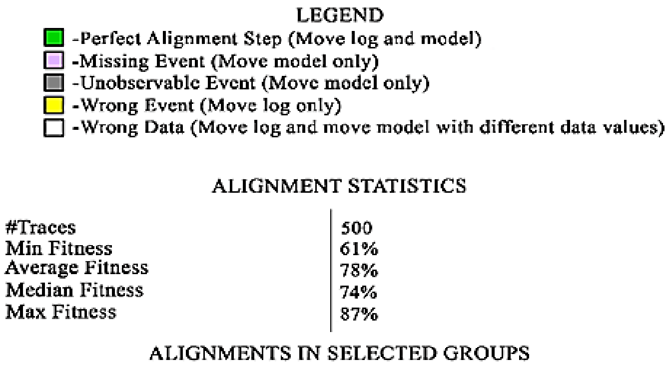

Fig. 4. Output conformance checking between traditional process mining and the initial theory model.

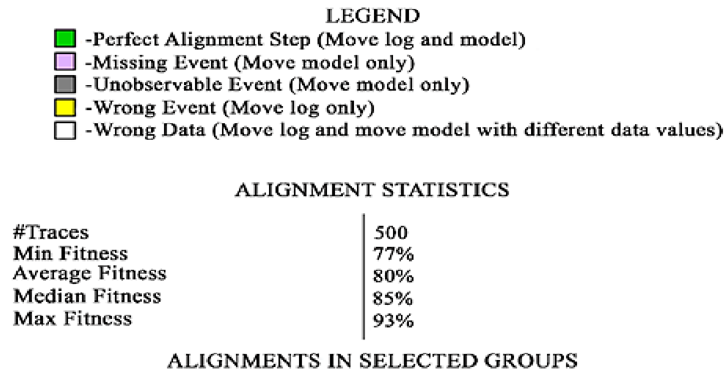

Fig. 5. Output conformance checking between blockchain-based process mining and the initial theory model.

4 | Discussion

Organizations often invest considerable effort in modeling their internal business processes to enhance visibility and control. These theoretical models provide a structured view of how operations should ideally function and are crucial for process optimization and digital transformation initiatives.

However, real-world executions frequently diverge from these predefined models due to unexpected conditions, process variations, or human factors. One of process mining's primary strengths is its ability to uncover the actual flow of processes by analyzing event logs, revealing deviations, redundancies, and bottlenecks that would otherwise remain hidden.

In this study, we compared two models: Model 1, derived from traditional ERP-based event logs, and Model 2, generated from smart contract interactions on a blockchain platform. The structure of both log datasets showed complete alignment (100% similarity), which can be attributed to the deliberate mapping of smart contract logic to the organization's existing purchase process.

This demonstrates that, when designed correctly, smart contracts can accurately reflect existing business logic. Nonetheless, if business rules or organizational structures change, the smart contract must also be updated to maintain alignment with real-world operations.

Table 3 summarizes the fitness scores obtained using the conformance-checking feature in the ProM tool. Model 2, powered by blockchain-generated logs, achieved higher conformance scores across all fitness metrics than Model 1, indicating a more accurate representation of the intended process.

Table 3. Comparison of fitness scores between Model 1 and Model 2 (vs. theoretical BPMN model as illustrated in Fig. 3).

Metric	Model 1	Model 2
Min fitness	0.61	0.77
Average fitness	0.78	0.80
Median fitness	0.74	0.85
Max fitness	0.87	0.93

These results confirm the advantages of using blockchain for event data recording in process mining. Additionally, detailed log data allowed for time analysis across individual activities, enabling the identification of execution delays and performance issues. While such insights could guide further improvements, our primary focus here remains on evaluating the benefits of blockchain integration.

Table 4 presents a comparative overview of key studies related to blockchain, smart contracts, and process mining within the context of the supply chain. It highlights each study's unique contributions, methodological approaches, strengths, and limitations. This comparison situates the current research within the broader academic landscape, emphasizing its empirical and integrative value.

Table 4. Comparative analysis of related studies.

Study /Reference	Focus Area	Key Contribution	Methodology /Data	Tools /Platform	Limitation	How Our Study Differs
[5], [6]	Blockchain in SCM	Highlighted fraud prevention & trust	Conceptual / Case-based	Not specified	No empirical testing or process modeling	We offer real implementation + model mining.
[15], [16]	Blockchain for food traceability	Reduced tracking time (Days to minutes)	Industry use case	Not specified	No integration with process analytics tools	We combine tracking + conformance analysis.
[21]	Smart contracts + lightweight encryption	Introduced IDSE algorithm for efficiency	Algorithmic proposal	Blockchain (Generic)	Not tested within a real business process	We embed real organizational logic in code.
[22]	Blockchain adoption in SCM	Conceptual mapping with SLR, NVivo	Systematic literature review	Leximancer, NVivo	No actual process execution or technical testing	We validate a working smart contract + mining.
[23]	Blockchain, trust, and uncertainty	Explored trust as a mediator	Interviews (31 experts) + thematic analysis	Qualitative tools	There is no technical solution, only conceptual links	We show blockchain's impact via event data.
[11]	Blockchain + process Mining (Concept only)	The proposed synergy between two technologies	Theoretical	Not implemented	No real-world data, no empirical validation	We realize the integration in practice.
Our proposed model	Blockchain-based process mining in SCM	Real-world smart contract + process mining	Case study: ERP vs. Ethereum-based logs	ProM, Ethereum, remix	Limited to one organization/process scope	First, to empirically compare blockchain logs.

5 | Conclusion

Traditional food supply chains are primarily dependent on centralized database systems, where all critical data resides under the management of a single IT unit. This centralization creates a single point of failure and vulnerability whether due to technical malfunction, cyber-attacks, or human error where data integrity, availability, and traceability can be compromised.

This research proposes a blockchain-based solution that decentralizes event logging using smart contracts. By encoding business logic into blockchain-based workflows, the proposed system mitigates the risks of data tampering, improves auditability, and strengthens transparency in supply chain processes.

Through a comparative analysis between traditional and blockchain-based process mining approaches, our findings demonstrate that blockchain-enabled event logs produce more accurate process models. Specifically, conformance scores improved significantly when logs were captured from the smart contract implementation of the goods requisition process.

One of this study's key contributions is demonstrating that process models can be programmatically implemented on blockchain platforms using smart contracts. These models are executable but also auditable, traceable, and resistant to manipulation. This provides a strong foundation for further research and application of blockchain technology in inter-organizational process integration and monitoring.

Future work can focus on scalability issues, integration with privacy-preserving mechanisms, and applying this framework to other industries with complex supply chains, such as pharmaceuticals or agriculture.

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References

[1] Van Der Aalst, W. (2012). Process mining: Overview and opportunities. *Association for computing machinery transactions on management information systems (TMIS)*, *3*(2), 1–17. https://doi.org/10.1145/2229156.2229157

[2] Dehghan, M., & Shakib, N. (2024). Process mining for situation awareness: A review of current practices and future prospects. *Journal of engineering and applied research*, *1*(2), 115–134. https://doi.org/10.48301/jear.2024.472780.1036

[3] Cao, B., Wang, Z., Zhang, L., Feng, D., Peng, M., Zhang, L., & Han, Z. (2022). Blockchain systems, technologies, and applications: A methodology perspective. *IEEE communications surveys & tutorials*, *25*(1), 353–385. https://doi.org/10.1109/COMST.2022.3204702

[4] Hugos, M. H. (2024). *Essentials of supply chain management*. John Wiley & Sons. http://dx.doi.org/10.1002/9781119464495

[5] Khoshgoftar, S., Feizi, H., & Dehghan, M. (2024). Revolutionizing product exchange: Implementing blockchain-NFT technology for ensuring trust in product transactions. *Journal of engineering and applied research*, *1*(1), 73–92. http://dx.doi.org/10.48301/jear.2024.444098.1019

[6] Tokkozhina, U., Lucia Martins, A., & Ferreira, J. C. (2023). Uncovering dimensions of the impact of blockchain technology in supply chain management. *Operations management research*, *16*(1), 99–125. https://doi.org/10.1007/s12063-022-00273-9

[7] Li, Y., & Chen, T. (2023). Blockchain empowers supply chains: Challenges, opportunities and prospects. *Nankai business review international*, *14*(2), 230–248. https://doi.org/10.1108/NBRI-06-2022-0066

[8] Van Der Aalst, W. (2011). *Discovery, conformance and enhancement of business processes*. Springer-Verlag Berlin Heidelberg. https://doi.org/10.1007/978-3-642-19345-3

[9] Van Der Aalst, W. (2016). *Process mining: Data science in action*. Springer-Verlag Berlin Heidelberg. http://dx.doi.org/10.1007/978-3-662-49851-4

[10] Rozinat, A., Mans, R. S., Song, M., & Van Der Aalst, W. (2009). Discovering simulation models. *Information systems*, *34*(3), 305–327. https://doi.org/10.1016/j.is.2008.09.002

[11] M'baba, L. M., Assy, N., Sellami, M., Gaaloul, W., & Nanne, M. F. (2023). Process mining for artifact-centric blockchain applications. *Simulation modelling practice and theory*, *127*, 102779. https://doi.org/10.1016/j.simpat.2023.102779

[12] Lau, H. C. W., Ho, G. T. S., Zhao, Y., & Chung, N. S. H. (2009). Development of a process mining system for supporting knowledge discovery in a supply chain network. *International journal of production economics*, *122*(1), 176–187. https://doi.org/10.1016/j.ijpe.2009.05.014

[13] Dehghan, M., Feizi, H., & Houshmand, S. (2025). Revolutionizing molten gold ownership transfer: Unlocking the power of blockchain technology. *Iranian journal of information processing and management*, *40*(Special Issue 3), 191–218. https://doi.org/10.22034/jipm.2024.2022763.1550

[14] Gamage, H. T. M., Weerasinghe, H. D., & Dias, N. G. J. (2020). A survey on blockchain technology concepts, applications, and issues. *SN computer science*, *1*(2), 114. https://doi.org/10.1007/s42979-020-00123-0

[15] Lorenz-Meyer, F. (2022). *Blockchain in the shipping industry-a proposal for the use of blockchain for smes in the shipping industry* [**Thesis**]. https://B2n.ir/pg4817

[16] Kshetri, N. (2023). Blockchain's role in enhancing quality and safety and promoting sustainability in the food and beverage industry. *Sustainability*, *15*(23), 16223. https://doi.org/10.3390/su152316223

[17] Wüst, K., & Gervais, A. (2018). Do you need a blockchain? *2018 crypto valley conference on blockchain technology (CVCBT)* (pp. 45–54). IEEE. https://doi.org/10.1109/CVCBT.2018.00011

[18] Tian, F. (2017). A supply chain traceability system for food safety based on haccp, blockchain & internet of things. *2017 international conference on service systems and service management* (pp. 1–6). IEEE. https://doi.org/10.1109/ICSSSM.2017.7996119

[19] Iansiti, M., & Lakhani, K. R. (2017). The truth about blockchain. *Harvard business review*, *95*(1), 118–127. https://B2n.ir/kg8390

[20] Xu, Y., Chong, H. Y., & Chi, M. (2021). A review of smart contracts applications in various industries: A procurement perspective. *Advances in civil engineering*, *2021*(1), 5530755. https://doi.org/10.1155/2021/5530755

[21] Puneeth, R. P., & Parthasarathy, G. (2023). Security and data privacy of medical information in blockchain using lightweight cryptographic system. *International journal of engineering*, *36*(5), 925–933. https://doi.org/10.5829/ije.2023.36.05b.09

[22] Vazquez Melendez, E. I., Bergey, P., & Smith, B. (2024). Blockchain technology for supply chain provenance: Increasing supply chain efficiency and consumer trust. *Supply chain management: An international journal*, *29*(4), 706–730. https://doi.org/10.1108/SCM-08-2023-0383

[23] Pattanayak, S., Ramkumar, M., Goswami, M., & Rana, N. P. (2024). Blockchain technology and supply chain performance: The role of trust and relational capabilities. *International journal of production economics*, *271*, 109198. https://doi.org/10.1016/j.ijpe.2024.109198

[24] Vom Brocke, J., Hevner, A., & Maedche, A. (2020). Introduction to design science research. In *design science research. Cases. Cham*, 1–13. *Springer*, https://doi.org/10.1007/978-3-030-46781-4_1