# Investigating the Potential of Smart Contracts in Automating Insurance Claims

**Sagar Girhepunje, Shravani Ekre**

G H Raisoni University, Amravati, Maharashtra, India

**Abstract**

The insurance industry helps manage risks through its provision of financial security against unpredictable events. The standard methods used to process claims require extensive manual checks and document handling and authorization from multiple parties. Organizations experience operational challenges through their use of traditional systems which result in slower processes and higher expenses and reduced system visibility and greater chances of fraudulent activities. The financial services industry needs automated security solutions for claim management systems because digital transformation continues to change its landscape.

Blockchain technology has emerged as a promising solution to address these inefficiencies. Its decentralized and immutable ledger structure ensures transparency, traceability, and data integrity. Smart contracts represent a major innovation that functions as self-executing digital agreements within blockchain ecosystems which automatically execute predefined conditions. Smart contracts use insurance policy terms embedded in programmable code to achieve automated verification and execution without requiring human oversight.

The research assesses how smart contracts can automate the process of settling insurance claims. The researchers demonstrate how to implement policy rules through blockchain systems which verify claims and initiate payouts upon meeting defined conditions. The system verifies claims through its ability to access trustworthy external data sources which include digital reports and IoT inputs via oracle mechanisms. The automated system reduces administrative costs while decreasing processing time and preventing fraudulent activities.

The research investigates implementation problems which include verifying data accuracy and ensuring oracle protection and establishing legal validity and enabling communication with older systems and meeting regulatory requirements. The combination of automation and complicated claims requires organizations to use hybrid systems which combine automated processes with manual control. The insurance industry needs to solve these technical and legal problems before it can start using this technology on a large scale.

Furthermore, the decentralized nature of blockchain ensures that all transactions and claim records are securely stored and cannot be altered once recorded. This immutability increases reliability and provides a verifiable history of policy agreements and claim activities. As a result, both insurers and policyholders benefit from improved accountability and secure data management.

The implementation of smart contracts also enhances operational efficiency by automatically executing claim settlements once predefined conditions are satisfied. This reduces administrative costs and processing delays that are common in traditional insurance systems. Additionally, the use of cryptographic security mechanisms protects sensitive user information while maintaining transparency in the claim verification process.

## 1. INTRODUCTION

The insurance sector serves as an essential component of contemporary economies through its ability to deliver financial safeguards which protect against uncertain events. The insurance industry continues to use traditional methods for handling claims despite technological progress which has transformed other areas of the financial sector. The conventional systems create a pattern of operations which generates delays in payment processing while raising business expenses and decreasing operational transparency and creating dissatisfaction among clients [1].Financial services undergo digital transformation which creates demands for secure automatic systems that need to be modernized in their claim management operations.

The blockchain system functions as an innovative solution which can fix multiple operational problems. The blockchain functions as a distributed ledger which operates without a central authority while maintaining its permanent record of all transactions[2]. The system includes smart contracts which function as automated programs that execute contracts when specific conditions are fulfilled. Smart contracts enable automatic claim verification and settlement processes through insurance policy rules embedded into programmable code which operates without requiring ongoing human supervision.

The use of smart contracts through automated systems for insurance claims processing leads to three major benefits which include decreased fraudulent activity with lower operational costs and faster payment execution [3]. Smart contracts gain the ability to verify claim conditions and execute payment processing through real-time mechanisms when they connect with trusted external data sources which include IoT devices and telematics systems and verified digital reports[1]. This process improves operational efficiency while establishing better trust between insurers and policyholders through its transparent and precise system.

The technical and legal and regulatory challenges which need to be solved before organizations can execute smart contract-based claim automation work because of the beneficial aspects [2]. The process of large-scale adoption requires solutions for three critical issues which include data reliability and oracle security and legacy systems and legal enforceability [3]. The research requires systematic study because the emerging method needs to be evaluated for both its potential benefits and its existing constraints.

The study tests smart contract capabilities for automating insurance claims processing through efficiency enhancement and transparent operations and cost reduction and customer satisfaction achievements analysis. The research uses current technological frameworks and practical considerations to create a secure blockchain-based insurance claim automation model that can scale effectively[4].



Fig1. Smart Contract-Based Insurance Claim Automation Framework

## 2. Literature Review

The rising complexity of insurance operations together with higher customer demands has led researchers to investigate technological systems which can boost operational efficiency while enhancing transparency and building customer trust. Blockchain technology stands out as one of the most important innovations because it has gained significant research and industry interest due to its decentralized design and permanent record-keeping system [5]. Researchers widely acknowledge that blockchain's distributed ledger system reduces reliance on centralized authorities while enhancing data integrity and traceability.

The development of smart contracts represents one of the most important advancements in blockchain technology. Smart contracts function as digital agreements which execute their embedded conditions through programmable scripts. Scholars emphasis their self-executing design because it removes the necessity of intermediaries together with decreasing administrative work and preventing manual mistakes [6]. Researchers have done extensive studies on smart contracts within financial services to examine their usage in payment systems and supply chain finance together with digital identity management, which showed clear operational efficiency improvements [1].

The insurance industry faces major issues with its conventional claim settlement methods which require extensive time and document processing and present opportunities for fraudulent activities [5]. Existing literature highlights that manual verification of claims often involves multiple stakeholders, including claim assessors, underwriters, and third-party investigators. The layered process which exists between various parties leads both increased operational expenses and extended time periods before customers receive their payments, which subsequently causes dissatisfaction among customers. Researchers provide evidence that using policy rules as components of smart contracts will simplify verification processes through automated systems which will execute payment procedures after reaching designated validation points [7].

The available research evidence from conceptual and prototype studies demonstrates that smart contracts enable companies to decrease their claim processing duration. The integration of predefined policy terms into blockchain-based systems enables automatic claim validation which checks compliance with established conditions [8]. Parametric insurance models use external event data to determine payout amounts by automatically processing verified data from trusted digital sources which include flight delays and weather information and accident confirmations. The automated systems remove all choice-based decision points which enables organizations to process claims without delay.

The literature identifies essential technical difficulties which need to be resolved. Smart contracts execute their functions exclusively within blockchain platforms which prevents them from retrieving data from outside the blockchain network. The system requires external data providers known as oracles to deliver off-chain information to resolve this issue[3]. Researchers establish that oracle systems need reliable operations and secure functions and decentralized development to maintain trustworthiness during automated claim processing. The system will face trust issues when data inputs suffer compromise because the system will generate incorrect payout amounts.

Permanent legal regulations and compliance requirements form a significant research area which researchers have identified in their existing studies[7]. Smart contracts execute their functions automatically yet legal experts still question their enforcement capacity across different legal systems. Academics explain that conventional contract law frameworks were created before autonomous code-based agreements became standard. The implementation of smart contract-based insurance models needs both regulatory guidelines and contemporary legal definitions to achieve compliance with present-day consumer protection laws and dispute resolution processes.

Academic research investigates adoption barriers through two main lenses which include technical aspects and legal matters. People continue to distrust algorithm-based decision systems especially when they evaluate complicated claims which need personal judgment[9]. Some researchers recommend hybrid systems which use smart contracts to manage routine claims but need human judgment for rare and unclear situations[6]. The industry needs this combined method because it enables organizations to implement solutions on a wide scale.

Recent studies have expanded the discussion by integrating emerging technologies such as Internet of Things (IoT) devices and artificial intelligence with blockchain frameworks. IoT sensors can provide real-time accident or environmental data which can automatically trigger claim verification processes. Artificial intelligence models can further enhance fraud detection and risk assessment [5]. The combination of these technologies improves the automation functions of insurance systems which use smart contracts for their operations.

The current research on the topic shows that smart contracts will revolutionize insurance claim processing because they will achieve faster processing times lower operational expenses and improved transparency while reducing fraudulent activities. The research shows that organizations need strong technical systems together with safe data sharing methods and clear regulatory frameworks to establish user reliability [7]. The research offers a comprehensive framework which enables future research on secure smart contract systems that support automated handling of insurance claims through scalable smart contract frameworks.

## 3. Research Methodology

The researchers use a qualitative research method together with a conceptual research method to examine how smart contracts can automate the process of insurance claim processing. The study seeks to explore existing technological systems to assess how blockchain smart contracts can enhance the efficiency and transparency and accuracy of claim settlement processes [9]. The research team conducted a systematic review which examined academic literature and industry reports and blockchain implementation studies to create a theoretical base and discover latest developments in automated insurance systems.

The research design uses an analytical framework which contains four main stages: problem identification, system conceptualization, implementation modeling, and performance evaluation. The research team discovered the inefficiencies that traditional claim processing systems create through their research which compared existing insurance workflows [10]. The system experiences delays because its manual verification process requires time and it incurs high costs for administrative work while it remains vulnerable to fraud and its operations lack transparency. The researchers developed a blockchain-based claims process automation system which they designed according to their research results [9].

The researchers built a prototype smart contract system which they tested using a blockchain simulation environment to assess its practical application. The research team developed a programmable smart contract system which included insurance policy rules that defined eligibility criteria and claim validation parameters and payout conditions [11]. The system design used oracle mechanisms to create virtual data inputs which included accident confirmation and event validation. The automated workflow system used predefined conditions as its verification method to activate the contract which then authorized claim approval and proceeded to handle a digital payout process.

The proposed model assessment used comparative metrics which included claim processing time and administrative intervention levels and transaction transparency and operational cost indicators to evaluate its performance. The study measured efficiency and reliability improvements by comparing these metrics to traditional manual claim processing methods [12]. The research investigated security parameters through the assessment of data integrity and immutability and fraud resistance within the blockchain system.

The researchers conducted an examination of legal and regulatory and technical obstacles which prevent the effective deployment of smart contract-based automated systems. The assessment of oracle reliability and system scalability and interoperability with existing insurance systems and compliance to contractual regulations was conducted through secondary data analysis and conceptual evaluation [14].

The methodology uses both simulation-based testing and conceptual analysis methods which do not include actual physical testing in real-world environments. The structured framework establishes a practical base which enables researchers to conduct empirical testing and pilot programs [13]. The research study combines theoretical examination with prototype modeling and comparative evaluation to create a complete assessment of how smart contracts work in automating insurance claim processing.

The study used a comparative case-based evaluation approach to improve its analytical methods. The existing traditional claim workflows were analyzed through a complete process mapping which showed their differences from the new blockchain-enabled workflow. [12] The side-by-side comparison process allowed for the discovery of redundant elements and identification of system bottlenecks which included determining the points where smart contracts could automate tasks instead of using human workers. The comparison process showed how efficiency improvements occurred because processing

stages and approval layers were eliminated during the comparison. The process modeling technique created a visual representation of the proposed system architecture [14].

The automated claim lifecycle process consists of five separate stages which include policy registration, claim initiation, condition verification, smart contract execution, and automated payout [7]. The analysis determined every phase's data requirements which included input data needs and systems validation rules and output results. The structured modeling approach developed a clear system that showed how predefined rules get incorporated into smart contracts and how event-driven mechanisms function within the blockchain system. The research team created hypothetical datasets which simulated real-world conditions to represent claim scenarios [12].



**Fig 2. Proposed research methodology framework.**

The datasets contained both authorized and unauthorized claim inputs which researchers used to evaluate contract functionality under various scenarios. The researchers tested the system's logical responses which included claim approval, rejection, and conditional verification to check whether they matched the rules defined in the system [15]. The simulation process evaluated the smart contract environment's capacity to execute operations in a reliable manner while handling errors and executing predetermined processes.

## 4. Result

The research conducted in this study demonstrates that smart contracts improve both operational efficiency and claim processing transparency for insurance companies. The smart contract-based framework enables organizations to complete claim verification and settlement processes at a faster pace than traditional systems because it automatically executes predefined conditions. Organizations can achieve substantial time savings through their work process optimization, which eliminates the necessity for manual tasks and administrative documentation [13].

The comparison study demonstrates that three essential performance metrics between two operational methods have shown measurable progress. The blockchain network stores all transactions, which creates permanent and visible records that make it difficult for anyone to change data or create duplicate claims [16]. Automated payouts that follow condition verification process improvements work to boost customer satisfaction because they deliver payments at a faster rate.

The study identifies existing practical challenges that need to be addressed. The adoption of blockchain technology in actual situations faces obstacles from four key problems: blockchain scalability, the need for dependable external data sources (oracles), system integration challenges, and existing regulatory frameworks [15]. The research findings indicate that smart contracts improve security and operational efficiency and establish trust in insurance claim processing when executed with appropriate technical and legal backing [9].

The study demonstrates that smart contract-based automation presents an improved method for managing insurance claims, which achieves better operational efficiency and system transparency and enhances security for organizations. The insurance industry can achieve its transformation goals through this method, which requires proper implementation and appropriate regulatory backing to modernize its claim management operations [12].
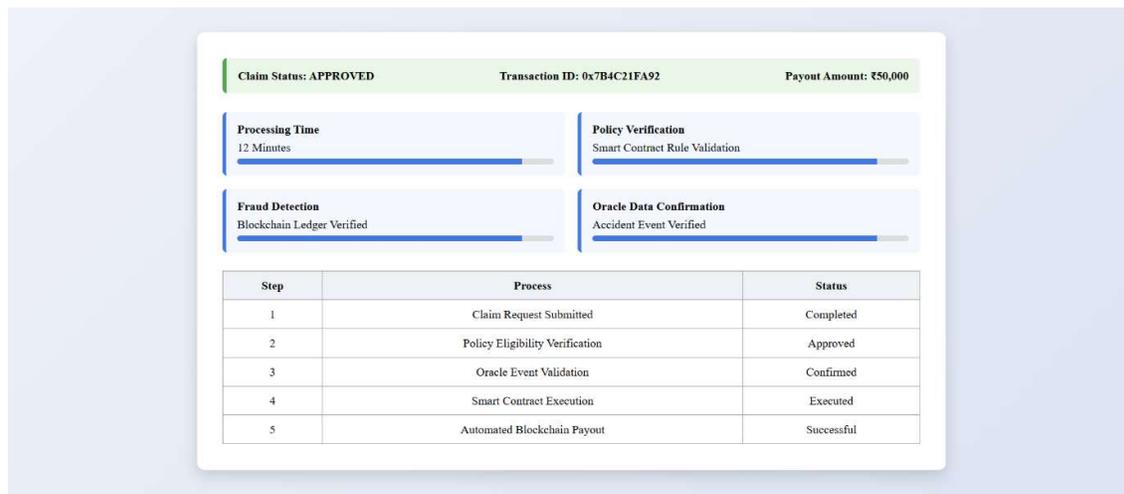
**Fig 3. Output of smart contract-based insurance claim automation system**

Smart contracts enable the insurance industry to achieve two benefits, which include faster processing times and improved operational transparency, while they establish greater responsibility standards throughout their entire ecosystem [14]. The system maintains complete accountability because it records every financial transaction that occurs within its framework.

## 5. Conclusion

The study demonstrates how smart contracts can enhance insurance claim processing through their automatic operational processes and their capacity to create transparent systems with advanced protection features. Traditional claim management systems often face delays, high administrative costs, and risks of human error or fraud. The implementation of smart contracts with blockchain technology enables organizations to tackle their existing challenges through automated verification and swift payout procedures [2]. Automated systems use less human resources because they eliminate physical tasks and establish an efficient process for managing insurance claims. The system achieves complete accountability through its transparent system that prevents unauthorized access and its permanent record-keeping system that protects vital information. The study results indicate that smart contracts present an effective solution for handling insurance claims despite existing barriers, which include scalability needs and compliance requirements and the need for system integration [5].

The combination of adequate technological systems and appropriate legal support will enable blockchain-powered automated systems to transform insurance operations into more effective and dependable industry practices. The implementation of smart contracts will enable insurance companies to accelerate their digital transformation initiatives [7]. The transition to automated digital systems enables companies to enhance their workflow management capabilities while boosting their ability to respond to operational needs. The new system empowers insurers to enhance their internal operations while gaining the capability to respond to upcoming technological developments [12].

The operational efficiency of smart contracts for insurance claim automation brings strategic benefits that extend beyond their immediate operational advantages. Insurers throughout the industry can increase their research and development activities and improve customer service and risk assessment processes by using automated systems, which help decrease their need for human intermediaries [15]. Automated systems create standardized workflows,

which help maintain consistent claim evaluation procedures while decreasing the possibility of evaluators making biased judgments. The implementation of this structural transformation will lead to increased organizational productivity and enhanced competitive abilities because organizations will need to adapt their business operations to current digital market trends. Blockchain-based systems provide transparent operations, which strengthen both accountability measures and audit capabilities. The distributed ledger permanently records all smart contract transactions, which establishes an unchangeable and trustworthy record of all claim-related activities [4]. This feature not only simplifies regulatory audits but also builds confidence among stakeholders, including customers, insurers, and regulatory authorities. Increased transparency can reduce fraudulent activities, which currently create substantial financial difficulties for insurance companies worldwide [11].

The system achieves faster claim processing through its automated settlement system which delivers predictable results to customers [9]. The system enables policyholders to experience higher customer satisfaction and improved brand trust through its features of reduced paperwork and real-time status tracking and faster payment processing. The insurance industry can use smart contracts as a digital service solution which matches current consumer demands for instant online services and fintech development. The system needs proper implementation strategies to maintain its benefits through extended time periods. Organizations must build secure blockchain networks and create strong oracle systems and develop rules for handling disputes [16].

Insurers need to work together with technology suppliers and regulatory authorities to build secure smart contract systems that meet legal requirements [10]. The system needs human expertise to handle complex insurance matters but smart contracts automate basic claim processes effectively. The system needs operational changes and transparency improvements and customer trust enhancement through its integration into the insurance ecosystem [18]. The complete potential of smart contract-based insurance claim automation requires further research

and pilot projects and regulatory progress to achieve successful implementation in actual situations [10].

## Reference

[1] "Chapter 7: SMART CONTRACTS in: FinTech." Accessed: Apr. 24, 2024. [Online]. Available: https://www.elgaronline.com/edcollchap/edcoll/9781800375949/978180 0375949.00018.xml

[2] N. R. Bhamidipati et al., "Claimchain: Secure blockchain platform for handling insurance claims processing," in 2021 IEEE International Conference on Blockchain (Blockchain), IEEE, 2021, pp. 55–64.

[3] C. Eckert, C. Neunsinger, and K. Osterrieder, "Managing customer satisfaction: digital applications for insurance companies," Geneva Pap. Risk Insur.-Issues Pract., vol. 47, no. 3, pp. 569–602, 2022.

[4] L. Zheng and L. Guo, "Application of big data technology in insurance innovation," in International conference on education, economics and information management (ICEEIM 2019), Atlantis Press, 2020, pp. 285– 294.

[5] M. Hanafy and R. Ming, "Machine learning approaches for auto insurance big data," Risks, vol. 9, no. 2, p. 42, 2021.

[6] L. Rukhsar, W. H. Bangyal, K. Nisar, and S. Nisar, "Prediction of insurance fraud detection using machine learning algorithms," Mehran Univ. Res. J. Eng. Technol., vol. 41, no. 1, pp. 33–40, 2022.

[7] D. E. Warren and M. E. Schweitzer, "When weak sanctioning systems work: Evidence from auto insurance industry fraud investigations," Organ. Behav. Hum. Decis. Process., vol. 166, pp. 68–83, 2021.

[8] J. Madir, "Smart contracts," in FinTech, Edward Elgar Publishing, 2021, pp. 175–198.

[9] A. S. Mishra, "Study on blockchain-based healthcare insurance claim system," in 2021 Asian Conference on Innovation in Technology (ASIANCON), IEEE, 2021, pp. 1–4.

[10] V. Kalsgonda and R. Kulkarni, "Role of Blockchain Smart Contract in Insurance Industry," Available SSRN 4023268, 2022.

[11] X. Lin and W. J. Kwon, "Application of parametric insurance in principle-compliant and innovative ways," Risk Manag. Insur. Rev., vol. 23, no. 2, pp. 121–150, 2020.

[12] K. L. Narayanan, C. R. S. Ram, M. Subramanian, R. S. Krishnan, and Y. H. Robinson, "IoT based smart accident detection & insurance claiming system," in 2021 Third international conference on intelligent communication technologies and virtual mobile networks (ICICV), IEEE, 2021, pp. 306–311.

[13] J. C. Mendoza-Tello, T. Mendoza-Tello, and H. Mora, "Blockchain as a healthcare insurance fraud detection tool," in Research and Innovation Forum 2020: Disruptive Technologies in Times of Change, Springer, 2021, pp. 545–552.

[14] A. Borselli, Smart contracts in insurance: a law and futurology perspective. Springer, 2020.

[15] C.-L. Chen, Y.-Y. Deng, W.-J. Tsaur, C.-T. Li, C.-C. Lee, and C.-M. Wu, "A traceable online insurance claims system based on blockchain and smart contract technology," Sustainability, vol. 13, no. 16, p. 9386, 2021.

[16] D. Oza, D. Padhiyar, V. Doshi, and S. Patil, "Insurance claim processing using RPA along with chatbot," in Proceedings of the 3rd International Conference on Advances in Science & Technology (ICAST), 2020.

[17] N. Dhieb, H. Ghazzai, H. Besbes, and Y. Massoud, "A secure ai-driven architecture for automated insurance systems: Fraud detection and risk measurement," IEEE Access, vol. 8, pp. 58546–58558, 2020.

[18] F. Loukil, K. Boukadi, R. Hussain, and M. Abed, "Ciosy: A collaborative blockchain-based insurance system," Electronics, vol. 10, no. 11, p. 1343, 2021.