Designing Smart Contracts on Insurance Claims to Support The Supply Chain Performance

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Abstract. Blockchain as a distributed ledger technology that can guarantee transparency and speed in real time is increasingly being used to increase supply chain performance directly or indirectly. Blockchain in the form of smart contracts in the insurance business will speed up insurance claims and increase transparancy, which will indirectly improve supply chain performance. This article aims to identify the role of smart contracts in increasing efficiency and applying smart contract designs to disbursing life insurance claims. The method for designing and implementing smart contracts was developed on the Ethereum platform involving several parties such as insurers, customers, and CAIPY Dapp. CAIPY is the name of the system being developed. CAIPY ensures that the system can prevent data manipulation, data leakage and guarantees the security of the smart contract itself. This research includes planning what data is needed in the smart contract design. Based on these data requirements, a system architecture, system mechanism is prepared, and closed with the design of a smart contract. This research produces a life insurance claim system in the form of a website by utilizing smart contracts. Analysis of the impact of implementing this system found an accelerated claim process, transparency of reasons for rejection in real time, and claims that are guaranteed as long as the conditions meet the policy requirements.

Keywords: Smart Contract, Insurance Claim System, Supply Chain Performance

1 Introduction

The use of technology in the supply chain is growing and the currently trending technology is the use of technology that can guarantee transparency and speed in a real time. Blockchain technology is a technology that can answer these needs. With its unique features, blockchain can provide an opportunity to reduce the effort and company resources required to confirm the status of a process, thereby speeding up the execution of the next process and being able to achieve the appropriate level of service efficiency [1]. This research will discuss the use of blockchain technology to guarantee

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the sustainability of a supply chain through smart contracts that will be tested on insurance business.

Insurance is divided into seven lines of business namely life, health, travel, property, workers' compensation, directors' and workers' liability, and general [2]. Fast insurance claims will directly expedite the flow of funds which are needed to support material procurement and expedite the production process to delivery in a supply chain. This research will focus more on life insurance. Life insurance was chosen because of its complex system, organized and complete claim flow that can be used as an example for other fields in a supply chain. There is a comparison table between existing studies with this system which is shown in Table 1.

Table 1. The comparison between existing studies.

Characteristic	**[9]**	**[10]**	**[11]**	**[14]**	**[15]**	**[16]**	**[17]**	**This research**
Areas	Car	Health	General	Market place	Helath	Cyber	Health	Life
Platform	Ethereum	Hyper-ledger fabric	Ethereum	Ethereum	Blockchain Insurance System	Ethereum	Ethereum	Ethereum
Parties	Insurer, consumer,court, CAIPY DApp, Ethereum, CAIPY Node	Block chain center, competent authorities, patient, media, insurance company, bank, arbitration company	Client, insurance company, agent, validator	Retail consumer, insurance agent, *agent*, dan *blockchain*	Admin, hospital insurance, AAJI, OJK, KPK, BMAI, law enforcer	Worker, requester, winner	Patient, hospital, insurance company, private key generation, blockchain, CA, smart contract	Insured party, insurer, Disdukcapil, Ethereum
Security	Can prevent data manipulation and privacy	Mutual authentication, resistance to man in	Safe against the following threats, namel	Safe against hacks and software bugs in Solidity and	Safe against fraud	Safe against attacks on all blocks that store task	Secure against indis-tin-guisha-bility under	Safe against fraud attempts between parties, safe against

	leaks, and smart contract security	the middle attacks, verifiability, integrity, traceability, openness, privacy, decentralization and information sharing, and non-repudia-tion	y modi-fy/delete client data, word endorsement, and wrong audition-ing result	smart contract infrastructure	information	chosen-plaintext attack (IND-CPA) with homo-morphic encryption	data leakage, safe in verification, and safe in transaction processing

Life insurance provides protection in death benefits and heirs [2]. This protection can be received if consumers officially submit it to the insurance company or better known as the claim process [3], [4]. The claim is an official submission to the insurance company to request payment per the provisions stated in the insurance policy that the consumers registered. In insurance, several parties are involved namely the insured party, the insurer, and the heirs. The insured party here is the party facing the risk stipulated in the insurance agreement. The insurer is a party that has a formal license to carry out business activities related to the assumption of risk from other parties and based on a policy. This risk insurer receives premiums from the insured party, and this insurer is an insurance company. Finally, the beneficiary is the party who receives compensation in the event of the death of the insured. The insured party must submit a claim within the time limit agreed upon in the policy's provisions. As for the claim, the process takes 14 working days starting from when the file is completely received by the company [4]. After the file is received, the next process that the insurance company will carry out is to investigate the claim. The result of this investigation is a decision from the insurance company whether to accept or reject the claim [5].

The claim process with a duration of 14 working days will be the topic of discussion in this research. An important event in the life insurance claim process is when the insured dies, various claims disbursement processes will be carried out. This process can be implemented into smart contracts. A smart contract is a series of programs that can verify and execute themselves through distributed database technology, such as blockchain, to help minimize the need for third parties [6], [7]. This technology carries

out an "if-then" condition in such that the user will pay a predetermined amount of money if the prerequisites in the contract are met [7]. Smart contracts also allow parties to impose conditions that if a transaction occurs, another transaction will also occur [8]. Blockchain technology provides data storage that is immutable, safe, transparent, and guarantees authenticity when a transaction process occurs. Many papers have discussed the application of smart contracts in the insurance industry, for example smart contracts in car insurance [9], other topics related to traceable insurance claims [10], the topic of safe insurance frameworks using blockchain and smart contracts [11]. This research will focus more on the application of smart contracts for life insurance business lines. The purpose of this study is to identify the role of smart contracts in increasing effectiveness and time efficiency in disbursing life insurance claims and designing the application of models of smart contracts in life insurance.

2 Methods

The research carried out is the design and application of smart contracts in the process of life insurance claims in the form of models and algorithms. The model will be designed based on a literature review to meet the objectives of this study. The algorithm for this smart contract will be developed and implemented in the website display. While the analysis includes trials and validation. Smart contracts are developed on the Ethereum [12] platform involving several parties such as insurers, customers, courts, and CAIPY DApp (CAIPY is the name of the system being developed). For its own security strategy, CAIPY ensures that its system can prevent data manipulation and data leakage and guarantees the security of the smart contract itself.

The data collection referred to in this research is in the form of planning what data is needed in the smart contract design. Based on these data requirements, it is necessary to prepare an architectural system, system mechanisms, and finally close with the design of the smart contract in this system.

2.1 System Architecture

The main parties involved: beneficiary (insured), validator (insurer), and smart contract. Several other parties involved: Department of Population and Civil Registration (Disdukcapil) [13], Police, and Bank.

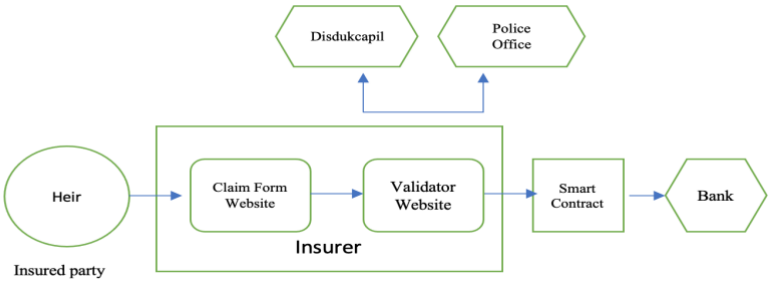

Fig. 1. System Architecture

2.2 System Mechanism

The design of this life insurance system is in the claim process, so it is assumed that all the data needed from the insured party has been completely fulfilled to run the system. When a condition occurs where the insured party dies, the heirs have the right to submit a claim to the insurer, which in this case is the insurance company. Claims on this system are made through the website provided by the insurance company.

The heirs will fill in the claim form provided on the website, and then the claim process will be forwarded to the insurance company, namely the validator. Suppose the claim does not violate the agreement that has been made. In that case, the heirs will automatically get the benefits that both parties have agreed upon when agreeing to an insurance policy through smart contracts.

The insurer or insurance company involved in this claim system is divided into two parts. The first part is a website that serves as a door for heirs to make claims, and the website contains a claim form that the heirs must complete. The second part is the validator, which verifies the administration.

This validator is a sworn staff at the insurance company where the task of the validator is to check the death certificate (verify data in the Disdukcapil database) and death statement (BAP or doctor's claim form or chronology of death) thoroughly, honestly, and responsibly. Validator work steps are as follows:

1. Receive notification of the policy claim verification process or check the policy that needs to be processed through the claim check page.
2. Enter the website and open the administrative verification page.
3. Enter the policy number of the insured party.
4. Retrieve the Population Identification Number (NIK) that appears on the site.
5. Check the status of the death certificate on Disdukcapil's web portal.
6. If the deed is found and the deed number matches, then proceed to Step 7. If the death certificate data is not found or the data does not match, the validator will contact the heirs through customer service.
7. The validator contacts the hospital or police to check the correctness of the letter. If the case is declared to exist and match, then proceed to Step 8. If the case does

not exist or match then the claim document is declared rejected due to an attempt to falsify the document.

8. The validator completes both questions for data authenticity with the "Valid" answer.
9. Submit the form.

After the validator does the input of the document authenticity condition, the smart contract will be released to perform its function. On the page where the smart contract is called, checks will be carried out, starting from the input of the claim form to the approval of the validator data. Then, the smart contract will update the data in the database regarding the date and time of the claim and the date and time of disbursement. After that, the insurance money will be disbursed to the heir's blockchain account in real-time. The system is depicted in Fig. 2.

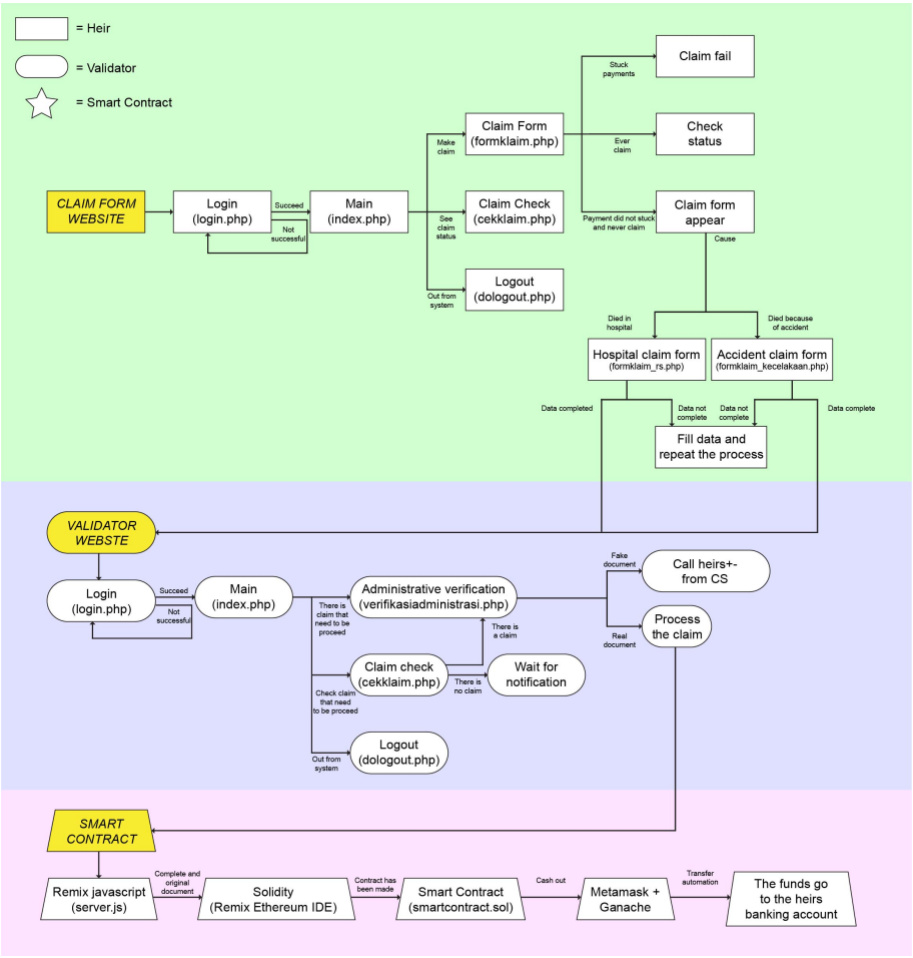

Fig 2. An Insurance Claim System With A Smart Contract

3 Design and Analysis

The design begins with database design, followed by website design, then analysis is carried out. The analysis includes evaluation and validation. Database creation is done using the MySQL Workbench 8.0 CE application. The database created in this study focuses on the needs of insurance claims. Design a website using the Sublime Text 3 application using the "php" programming language.

When we open the website for the first time, the heirs will see the Login page to the SACON insurance. Giving the name SACON Insurance is used for branding purposes so that the claim system by utilizing this smart contract is easier to remember.

The smart contracts design using the Remix Ethereum IDE, Ganache, Metamask, and Sublime Text 3 applications. Remix Ethereum IDE is used to develop smart contracts, Ganache and Metamask are used for simulating Ethereum values, and Sublime Text 3 is used for coding from PHP, Web3, Java Script and the required Solidity. This smart contract will later automate the transfer when the event conditions have been met.

3.1 System Security

Security is divided into three parties: the insurance company, the insured party, and smart contract security. For the insurance company, the system can prevent double claims made by utilizing an online-based system connected to a central database. In addition, fraud on claims by falsifying deaths can also be overcome by working with Disdukcapil.

From the insured's side, the system also provides security from the use of smart contracts with a guarantee that claims will be disbursed after all conditions are met, and there is no data falsification. For the security of this system itself, security is obtained by double verification of the validator with a password and security code. In addition, from various studies, the use of smart contracts can carry out its functions in real-time and has been proven to be safe against various attacks.

3.2 Advantages and Disadvantages

Many companies offering life insurance protection often make the public hesitate to choose. By utilizing smart contracts, insurance companies can increase users' trust by guaranteeing that if the claims made are appropriate and do not violate the agreement on the policy, the funds will be disbursed at that time. The advantages of this existing system can be applied to various other fields in the supply chain. The advantages of this system are shown in Table 2.

Table 2. The advantages of this system.

	Current System	**SACON**
Reason for refusal	>1 days	Real time
Disbursement of funds	< 7 days	Real time

Claims by heirs	Through customer service	Through website

In addition, through the implementation of this system, the distribution of information from the supply chain side has experienced reductions in waiting time and document delivery. Meanwhile, the disadvantages of the system lie in the absence of global integration with the central system in the government; thereby, this system still involves humans in its implementation, which in this case, is the validator.

4 Conclusions

The use of technology in the supply chain that can ensure transparency and speed in real-time is a goal that various studies try to achieve. Blockchain is one of the technologies that can answer these needs. This research discusses the use of blockchain to ensure the sustainability of a supply chain through smart contracts, which are tested in the life insurance service industry. Thus, two objectives are obtained: designing smart contracts for the life insurance service industry claim process and analyzing the impact of implementing smart contracts on the life insurance claim process.

The making of a smart contract is accompanied by a website for both parties: the insured and the insurer. The claim begins with the heir (insured party) filling out a claim form on the website, which will then be validated by the validator (insurer), triggering the smart contract to automate the claim to the heir. Smart contracts are proven able to do their job in real-time. This has resulted in the acceleration of several claim processes compared to the current system. In addition, with the reasons for rejection open to both parties, this system can also increase the trust of both parties. Thus, it can be concluded that by applying this smart contract, the life insurance industry claims process becomes faster because the process is carried out in real-time and is more transparent with the results known at that time.

Based on the analysis that has been carried out, there are several obstacles encountered in implementing smart contracts in life insurance services, namely the integration of a national scale system, several factors of fraud by customers that cannot be detected by the system, and the public's unfamiliarity with the blockchain payment system.

This research is a basic concept that can be developed more broadly for the needs of the claims process in the life insurance service industry and industries in other supply chain fields. Therefore, it is hoped that this research can help the development of other research in the future related to smart contracts, life insurance, and supply chain.

Suggestions for future research development include integrating the system with the Disdukcapil database to reduce human involvement in this decision-making and encourage development in life insurance related to the application of smart contracts in blockchain for the life insurance registration process.

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