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DOI
10.1145/3598469.3598509

Publication date
2023

Document Version
Final published version

Published in
Proceedings of the 24th Annual International Conference on Digital Government Research - Together in the Unstable World

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ABSTRACT

Corruption is widely spread and not easy to avoid. Blockchain-based smart contract technology enables the opportunity to develop transactions in such a way that corruption should not be possible. In this paper, we develop and evaluate an arrangement based on blockchain-based smart contracts to avoid and reduce corruption. Smart contracts are used for buying and selling goods, in which the public must agree that the goods arrived and are used to contribute to the creation of societal value. Only then will the supplier be paid. Al transaction data is stored in a blockchain and opened to the public to create transparency. In this way, the price of the good and the sellers can be inspected to avoid price manipulation and nepotism. The smart contract avoids the likelihood that corruption will happen, and it can be spotted if it happens.

ACM Reference Format:
Darusalam, Dr, Darusalam, Marijn, Prof, Janssen, Jamaliah, Prof, Said, Normah, Prof, Omar, and Muhammad Indra Saputra. 2023. Smart contracts for creating transparent transactions to reduce corruption. In *24th Annual International Conference on Digital Government Research - Together in the unstable world: Digital government and solidarity (DGO 2023), July 11–14, 2023, Gdańsk, Poland*. ACM, New York, NY, USA, 7 pages. https://doi.org/10.1145/3598469.3598509

1 INTRODUCTION

Blockchain-based smart contracts can disrupt traditional governance structures by reducing bureaucracy through lower transaction costs and reducing moral hazard [1]. A smart contract is a programmed functionality that executes one or more parts of the legal contract [2]. Smart contracts can be applied in many different ways, with varying goals and circumstances [3]. de Souza, Luciano [4] propose to use smart contracts for all government payments as a way to increase transactions' transparency, as well as to avoid overbilling. Yet how smart contracts can be used in practice and their broader organizational implications are hardly explored.

A *smart contract* can be defined as "a mechanism involving digital assets and two or more parties, where some or all of the parties put assets in, and assets are automatically redistributed among those parties according to a formula based on certain data that is not known at the time the contract is initiated" [5, para. 2]. A smart contract is a program that runs on a blockchain and its correct execution enforced by the consensus protocol (Luu et al., 2016). A smart contract contains information about a deal and will only be executed if the conditions are validated by nodes in the network (Luu et al., 2016).

The ledger itself is used by smart contracts to trigger transactions automatically when certain pre-defined conditions are met (Buterin, 2013). The rules in the smart contract define the conditions that need to be met before a contract is executed. The rules in the contract can be pre-defined, and agreement is reached by simply submitting if one agrees. These contracts are formalized in machine-readable code and will be executed automatically when the agreement conditions are met (Glatz, 2014). Smart contracts can be used to avoid corruption by ensuring that contracts are only executed when all conditions are met. The blockchain features are used to ensure the contract's transparency and that consent will be given for conducting a transaction. Furthermore, blockchains and smart contracts can reduce transaction costs by standardizing transaction rules and defining them in advance.

Blockchain-based smart contracts introduce new ways of aligning interests of stakeholders in a decentralized way [6]. Suppliers will be incentivized to act according to the agreement because else no payment will occur. Due to the transparency, others can oversee

DGO 2023, July 11–14, 2023, Gdańsk, Poland

ACM ISBN 979-8-4007-0837-4/23/07…$15.00
https://doi.org/10.1145/3598469.3598509

what is happening. In such a situation, data, systems, people, and rules (Janssen & Kuk, 2016) make up the smart contract materiality and should be considered when designing smart contracts for tackling corruption. Smart contracts should be seen as complex assemblages of social and technical artifacts, human actors, and socio-material routines enacted to reduce corruption.

The potential of applications based on blockchain technology for governments is hardly explored in a systematic way [7]. Contracts are a very complex subject, provided they are the main way governments transfer money to other organizations, including private ones [4]. This policy paper aims to evaluate how smart contracts can be used to avoid and detect corruption. The next section will discuss the literature background, followed by the research approach. The pilot case study is presented in section four, and the concepts for reducing fraud are discussed. This is followed by an evaluation of the benefits and issues that need further research. Finally conclusions are drawn.

1. Literature Review

Several studies have examined the use of smart contract technology, e.g., blockchain and blockchain-based smart contracts, as a potential tool to combat fraud in public procurement [8-10]. Smart contract technology has the potential to support public government activities because of some benefits such as security, trust, transparency, and collaboration [11]. The literature review discusses the main advantages and challenges of using smart contract technology to tackle corruption. This section examines the literature related to these two factors: smart contract technology and control of corruption.

Many studies found that ICT development through e-government could reduce corruption. Backus [12], in a study of three developing countries Ghana, Tanzania, and Kenya, found that e-government plays a vital role in the country's socio-economic development by reducing corruption and strengthening democracy. Bhatnagar [13], in a report title *e-government and access to information,* concluded that the process of building an online delivery system requires that rules and procedures be standardized through the use of computer coding. An effective e-government system will build in the system the ability to track the decisions and actions of individual civil servants. Such greater transparency and accountability in access to the information are expected to reduce corruption effectively.

According to Ali and Gasmi [14], ICT development is an important method for curbing corruption. Many governments quickly embraced the internet to create public administration such as e-government services. E-government refers to electronics' use to simplify the relationship between government, people, business, and government operation [12, 14]. The e-government implementation helped to improve the government's connectivity and engagement with its people. E-government enhances the government's transparency and accountability. Also, there are several ways ICT can be utilized to help strengthen government transparency and increase anticorruption [15]. ICT development improved and expanded public access to government information across various collaborative such as internet connection through multiple media. E-government allows connecting people who otherwise can not find details of the government information, such as government spending and public services. In addition, through ICT, society can participate in reporting the corruption practice in their country.

Krogsbøll, Borre [9] studied the implementation of smart contract technology for a social benefit process by the Syddjurs Municipality government in Denmark. The study developed a prototype implementation in the process of collaboration with a Danish Municipality. They found that the implementation of the collaboration provides some benefits such as integrity, direct collaboration, and payments between the parties. They argue that the smart contract implementation in the public government needs to be immutable and out of control from the government. On the other hand, the government has to change the law and provide a solution for the rare case when errors in the contract implementation result in unlawful behavior.

In South Africa, an analysis of blockchain-based platforms as a feasible solution to the problem of corruption in public procurement was analyzed by providing a high-level review of the legal and practical issues that could prevent using such platforms [10]. The paper illustrates the decentralized nature of blockchain-based smart contracts as a possible feature of fighting fraud and corruption involving government parties. The authors also discuss the legal problems with using a smart contract as a real contract since there are no resources and there is no way to cancel tender procedures or contracts.

The Mexican government introduced blockchain for public procurement [16]. Public institutions, universities, and civil society organizations adopted a blockchain governance model as part of the Mexican solution. The Mexican government created five smart contracts utilizing Ethereum to cover the following stages: government entities tendering registries, bidder's registration, bidder's prequalification process, the bidding process, and proposal assessment and selection. In the Seoul district of South Korea, the government devised a smart contract to increase the transparency and fairness of the review procedure.

Basically, in the 1970s and 1980s, the economic theory of asymmetric information was created as a rational reason for market failures. The theory suggests that an imbalance of data will lead to market failure between buyers and sellers. Information asymmetry affects business transactions in three primary ways. Firstly, adverse selection refers to a business relationship where different knowledge is available to the buyer and seller (although one information set is not necessarily superior to the other). Secondly, moral hazard happened when a company or person takes on the increased risk because it is not personally facing the full consequences of that high risk. Finally, monopoly of knowledge, in this situation, only a chosen person is presented with the necessary information to understand a situation and make a decision. A monopoly of knowledge can occur in private and public governments, where only officials with security clearance can be informed of privileged intelligence. In several businesses, only top management got full access to company information provided by the third party. However, a low-level employee may be called upon to make critical decisions with only limited information at their clearance (see Kim and Verrecchia, 1994; Li, 2008; Loughran and McDonald, 2014; Amiram et al, 2016 and Guay, 2016).

The current literature shows that the implementation of smart contracts faces many challenges, including how to use the contract

and define the conditions for executing a smart contract. Although there are examples of using blockchain-based smart contracts for reducing corruption, there is no research into specific applications in which the public is involved in reducing corruption. Furthermore, the examples found in the literature are not easily generalizability as these are context specific.

2 RESEARCH APPROACH

The study aims to evaluate how smart contracts can be used to avoid and detect corruption. This study uses a qualitative research approach to explore how smart contracts in Indonesia improve public service delivery and reduce corruption by improving transparency.

- Sample Size and Data Collection

The research method used in this study is a single case study via interview and observation at the village in South Sumatra-Indonesia named as Tanjung Batu, Kecamatan Tulung Selapan, Palembang-Indonesia. A case study allows for the investigation of a real issue within a defined context by utilizing various data sources (Yin, 1994). A case study "investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not evident" [17].The data is collected through structure interview from Head of the village, village finance officer, and village secretary.

Additionally, Eisenhardt and Graebner [18], and Graebner (2007) stated that various data sources are used in a case study to examine an actual problem within a defined context [17]. Using empirically supported case studies to generate theoretical constructs, propositions, or midrange theories is a common research method [19]. A case study is an empirical description of a phenomenon based on various data sources([17]. In addition, the case study is a comprehensive method that incorporates specific data collection and analysis approaches into the logic of the research strategy's design. In this study, the case study serves as a comprehensive research strategy to find the best answer to a specific research question rather than just collecting data about the topic. A pilot case study was used to develop the ideas for the smart contract an evaluation its impact.

- Pilot case study: Village funds in Indonesia

Village funds are funds sourced from the state budget intended for villages transferred through district/city budgets, and village funds are used to finance government administration, development implementation, community development, and community empowerment. Village funds are defined as funds originating from State Revenue and Expenditure Budget (APBN), which are intended for Villages transferred through the Regency/City APBD and used to finance government administration, development implementation, community development, and community empowerment.

The government provides the Increased village income to improve community service facilities by fulfilling basic needs, strengthening village institutions and other activities needed by village communities which is decided through the Village Musrenbang (community forum in conveying aspirations, criticisms and suggestions from Government programs). However, the existence of the Village Fund also raises new problems, namely that only a few people are concerned about the management of the Village Fund, which provides the opportunity for conducting fraud. This is related to the condition of village officials who are considered to have low-quality human resources, and the community is not yet critical of the management of the village revenue and expenditure budget (APBDesa), which results in hardly any supervision and control of appropriate behavior [20-22].

The Tanjung Batu village is situated at, Ogan Komering Ilir district, South Sumatra province, Indonesia. The total population on this village is around 1000 people. The profession of most of the villagers is farming and their literacy level is very low. The nature of population is simple innocence. Tanjung Batu has an area code according to the Ministry of Home Affairs 16.02.11.2004. While the postal code is 30655. Village only have one elementary school, and one basic health unit. The village administration is small due to small number of population. The selection of interviewee is based on number of population. Due to small number of population there was only one finance officer, head of the village and village secretary. So, interview all this three people to collect data for this study. This village is selected as a sample of smart contract to control corruption because the previous head of the village was involved in corruption scandal and the distribution of fund was not transparent.

Figure 1 shows the overview of the process of distributing village funds. Distribution of Village Funds is carried out in stages, with the following conditions:

- The Village Head submits the Village Fund disbursement file to the sub-district head
- The sub-district head, as the head of the District Village Fund Facilitation Team, verifies the Village Fund disbursement documents, including the following matters
- After being declared eligible by the District Village Fund Facilitation Team, the Head of the District Village Fund Facilitation Team makes a Letter of Recommendation to the Regent
- The Head of the Community Empowerment and Village Administration Service as Chair of the District Village Fund Facilitation Team issues a letter of recommendation for disbursement of Village Funds to the District Head Cq Head of the Financial and Asset Management Agency
- The Head of the Regional Financial and Asset Management Agency, on behalf of the Regent, carries out the transfer from the Regional General Cash Account to the Village Treasury Account
- After receiving the Village Fund book transfer from the Regional General Cash Account, disburse it to the Village Cash Account.

While the objectives of Village Fund Allocation are:

- Overcome poverty and reduce inequality.
- Improving the quality of development planning and budgeting at the village level and empowering village communities.
- Encouraging the development of rural infrastructure based on justice and local wisdom.
- Improving the practice of religious, social, and cultural values to realize an increase in social welfare.
- Improving services to rural communities
- Encouraging increased self-sufficiency and mutual cooperation of village communities.

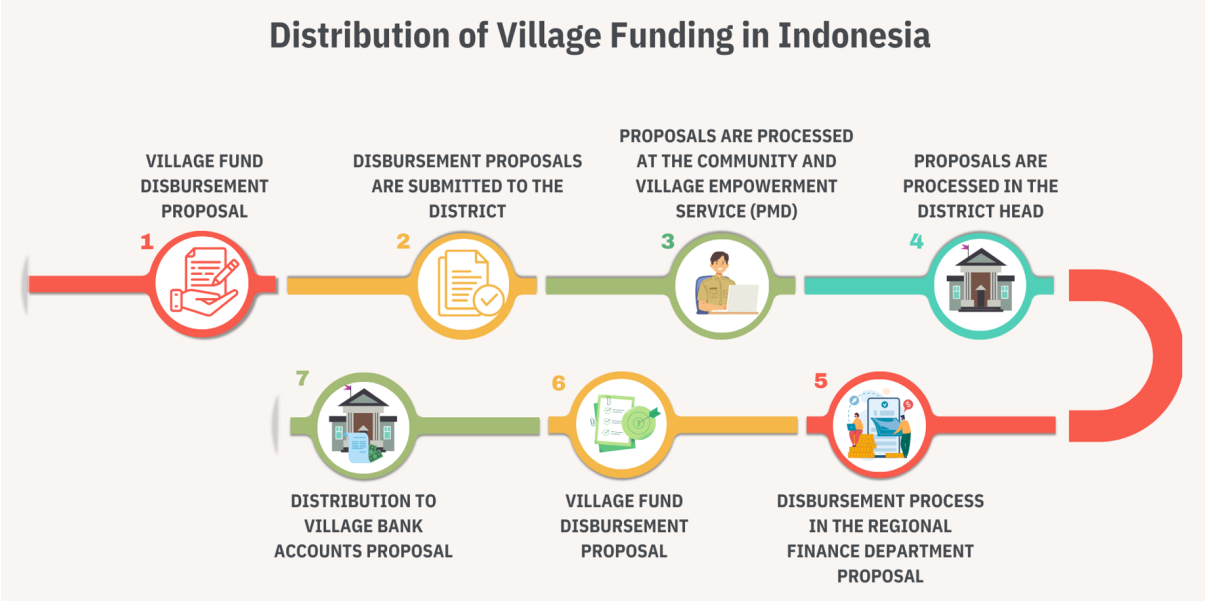

Figure 1: The current process of distributing villages funds

- Increase the income of villages and village communities through Village Owned Enterprises (BUMDes).

Use of the Village Fund Allocation received by the village government 30% of the village fund allocation is used for village government operations in financing village operations, BPD operational costs, and operational costs for the village fund allocation organizing team. Whereas 70% of village funds are used for community empowerment in the construction of village economic facilities and infrastructure, empowerment in the fields of education, health, community economic empowerment, especially for alleviating poverty and financial assistance to heads of village community institutions, BUMDes, business groups according to the economic potential of village communities, as well as assistance finance to institutions in the village.

- Smart contracts development and use

Smart contracts can be developed in various stages and require first 1) the design of the smart contract and, after that, 2) they can be implemented, and finally, 3) executed. First, the development of the smart contract, agreements that are acceptable need to be developed. The parties should agree on the conditions that the smart contract will be executed and be prepared to enter the data needed. In particular, in the case study, it was important that several people in the village act as a kind of 'trusted party' to verify that the goods would be delivered. This would require the following roles

1. Village financial officer: who provides the funds
2. Village procurement officer: who provides the name and description of the goods needed
3. Suppliers: who bid for and, if the quote is accepted, deliver the goods
4. Trusted party: who checks if the goods are delivered and satisfy the quality criteria.

Second, the contract needs to be implemented, and third, the contract needs to be executed. A prototype of the working of the smart contract needs to be developed on the transfer of ownership of goods bought by the village. First, the Village procurement officer specified the goods needed, including their quality. Then suppliers can provide a quotation for the selling and delivery of the goods. Then the supplier will be selected. This bidding process can also be automated in a smart contract in future research.

The village house enters the sum of money that needs to be paid for the goods into a block. Only if the sellers confirm that the goods are delivered, the village confirms that the goods are received, and one or more of the trusted and independent persons living in the village confirm that they have used the goods will the payment be processed and the transaction updated. Who those trusted and independent persons are should be defined in advance. Also, it is possible to have a minimum number of trusted people who agree on the receipt of the goods before the transaction is settled. The more people confirm, the more sure that the goods are delivered with the right quality; however, the longer it might take to get a confirmation. This is the 'many eyes' that should ensure that the right product is actually delivered. The money is returned to the village if the good is not transferred. The smart contract contains rules for the transaction that cannot be changed during the process nor interfered with by one of the parties without the other one knowing. The smart contract might outline that others (trusted parties) must confirm the transfer before the contract is executed to avoid disputes and ensure trust.

- Smart Contract Benefits to Reduce the level of corruption

Utilizing technology to prevent or mitigate misbehavior is crucial when addressing corruption caused by fraud [23]. Smart contracts are challenging because they are the main way governments send

money to other groups. Economics says that a contractual agreement creates an "agency dilemma," which could have one of two outcomes. Firstly, a moral risk resulting from *asymmetric information* is the principal's inability to see and confirm the agent's conduct. The issue arises when the agent may decide on behalf of the principal [24, 25]. Secondly, the contract is inadequate because the parties can't think of everything that could happen during the contract. It can happen because of asymmetric information between the principal and agent because one of them may not have sufficient information related to the contract [26, 27]. As a result, information for all parties is essential to manage contract risks, and its absence may limit the parties' capacity to trust one another. Lack of Information can also contribute to the spread of corruption.

Therefore, the advantage of the smart contract is to minimize information asymmetry. For this, a smart contract can enable that information becomes accessible to all parties to create transparency. The details of the contract should be available to the general public if one of them is a governmental organization. Furthermore, contracts cannot be changed by others without being noticed, as in the blockchain the whole history is stored, and there is a need for consensus voting to make changes. In this way enhancing its assurances and declarations and minimising asymmetric information. The management and preservation of bid contracts using smart Contracts can be listed as one of the Blockchain applications in public organisations, along with the transfer of cash from one level of government to some other or from governmental and non-governmental firms. Smart Contracts can be used for all government payments to make transactions transparent and prevent overcharging by suppliers. This mechanism is needed because contracts and bids are often used to commit fraud and steal money. The self-execution functionality of contracts can reduce the costs of conventional payments and the risks of fraud and bad behavior. It can also make it easier to get information and be more open.

With village crowdfunding based on blockchain technology, this technology can increase transparency and public trust in village fund corruption cases that often occur in Indonesia. The blockchain's decentralized nature will create transparency and also the control of village heads to be more open in working to serve the community. It's not only the village head who feels the impact, but the regional head also no longer needs to rely solely on the contents of actual reports from the village head, which might be subject to manipulation. Regional and central heads can also view the history of realized transactions and their conditions on the blockchain network. In view of the potential results from social and cultural aspects, this blockchain-based village crowdfunding can be the birth of cultivating honesty and increasing social justice, however, other measures might need to be necessary and should be investigated in further research..

There are many characteristics of blockchain and smart contracts as part of the socio-materiality assemblage reducing corruption. This can be decomposed into a number of advantages, as shown in Table 1. We derived the advantages by looking at blockchain literature discussing their advantages [28, 29] and by investigating how they occurred in the case study. The whole system aims to ensure that the information stored in a system corresponds to reality; in this way, minimizing the opportunity for conducting fraud. Information is stored in multiple ledgers, which should ensure access by the public.

Although there are many benefits, there are also several weaknesses that might prevent adoption and requires further research. The settlement of disputes through smart contract execution is difficult to implement [32]. The trusted persons and other parties should ensure that they behave correctly, but their individual incentives and interests might influence them. Therefore, there might be a need to do external auditing by organizations independent of the village and ensure that disputes can be resolved.

For smart contracts, the Ethereum platform can be used. However, Ølnes and Jansen [33] plea for a BCT-based platform for running various applications in e-Government. This might make development easier and enables the reuse of proven part. Furthermore, it is crucial to have an authentication, authorization, and accounting (AAA) module in place to prevent somebody from entering data instead of another person. More research in a joint infrastructure that provides all features needed for smart contracts to avoid corruption is needed.

Smart contracts are complex assemblages of social and technical artifacts, human actors, and socio-material routines enacted to reduce corruption. Research is needed to fully understand the drawbacks of these smart contracts and how to deal with them. Alongside the trust in the social aspects of smart contracts, the technology should also trust and, to some extent, understand the features of blockchain technology. We recommend risk assessment and vulnerability testing of the application in future research. In this way, the possibilities for corruption and fraud can be evaluated.

3 CONCLUSIONS

The use of smart contracts for reducing corruption should be seen as complex assemblages of social and technical artifacts (smart contracts, blockchains), data, human actors, and socio-material routines enacted to reduce corruption. The smart contract needs to be designed and implemented. This requires both contracting and legal knowledge and technical knowledge for implementation. Furthermore, the social environment should be mobilized to ensure that the smart contract will work. In this case, the public should be aware that they need to provide the information to confirm that the goods have arrived. In this way, the chance of corruption is reduced, as there are more 'eyes' who can check if the process has been correct. In contrast, more people involved also complicates the settlement process, if the public does not submit their confirmation about the goods, then the suppliers will not be paid. In this way, the risks for fulfilling the contract are shifted. This shows the importance of viewing smart contracts for reducing corruption as complex socio-technical assemblages.

In our subsequent research, the effects on corruption will be evaluated in practice. Smart contracts make it possible to prevent fraud because of the blockchain technology that can decentralize smart Ethereum contracts so that agreements that have been made can be fair with a high level of trust. The study intends to assess how smart contracts can be utilized for accountability transactions to reduce potential corruption in village funds in Indonesia. The current and new situations will be compared and accessed in practice, and

Table 1: Overview of advantages and explanation

Advantages	Explanation
Trust	Others need to confirm the transaction. This can be multiple persons to avoid that a single person can be bribed to ensure that the blockchain is executed.
Transparency of product and payment	The amount of the payment and the goods are stored. In this way, it can be evaluated if a fair price is given.
Transparency of parties	The parties who sign on behalf of the village, the supplier, and trusted persons can be stored. The storage of trusted persons is a trade-off between privacy, vulnerability, and transparency. Trusted persons
Auditability	The distributed ledger is open and accessible to others. In this way, others can track the transaction history, and an audit trail can be created. Also, the responsibilities are clear, and people can be held accountable if they do not keep their responsibilities.
Reliability	The smart contract ensures that only money is exchanged when all relevant parties agree. The money is already transferred in advance by the village. So the seller does not have to worry about getting the money. The village will get the money back if the transaction is not conducted and no money has been lost.
Immutable	Smart contracts are almost immutable. Uploading bytecode, executing a constructor function, and storing the code on the distributed ledger prevent undesired updates [30].
Flexibility	Although contracts are hard to be altered or updated once agreed upon, the contract execution is flexible.
Accuracy	The accuracy of smart contracts is proportional to the precision of the code. Smart contracts, which are built on blockchain, provide data immutability, allowing parties to make contracts without knowing each other and eliminating contract breaches or management errors.
Security	As contracts and data is stored in multiple ledgers using encryption manipulation is more difficult Gervais et al. (2016);. Smart contract security refers to the security principles and procedures employed by developers, users, and exchanges while engaging with or implementing smart contracts.
Efficiency	Using smart contracts in financial transactions can make them faster, more efficient, and less reliant on third parties like the government and the head of the village. This improves creditworthiness and the integrity of business dealings.
Trust	Trust in the execution of the contract due to immutable recordkeeping and by verification of the data by multiple parties and nodes [29, 31];

risk analysis will be conducted. We will investigate if additional procedures, routines, and other measures are needed to ensure that smart contracts will work in practice.

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