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Smart Contracts: Assessing the Validity and Enforceability of Civil Law in Blockchain-Based Transactions

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ABSTRACT

Smart contracts are an innovation that emerged along with the development of blockchain technology, offering automation in the implementation of agreements without third-party intervention. However, the existence and application of smart contracts in the context of civil law still raises various questions regarding their validity and enforcement. This study aims to explore the legal challenges faced by smart contracts, as well as how civil law can accommodate and enforce agreements made in digital form. The research methodology used is qualitative analysis through literature studies and interviews with legal experts and industry practitioners. The results of the study show that although smart contracts offer efficiency and transparency, there are concerns regarding validity, legal recognition, and potential disputes. The novelty of this study lies in the integration of positive law and technology perspectives in understanding the dynamics between smart contracts and civil law. The social implications of this study include the need to develop adaptive regulations to regulate smart contracts, as well as increasing public understanding of the risks and benefits of using technology in legal transactions.

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INTRODUCTION

Smart contracts, which are part of blockchain technology, are increasingly being used in various sectors, from finance to supply chain. The main advantage of smart contracts is their ability to automate the execution of agreements, thereby reducing the need for intermediaries and increasing transaction efficiency. According to Nakamoto (2008), blockchain enables decentralized and transparent transaction recording, which makes smart contracts a very attractive tool in the world of civil law.

However, despite this promising trend, civil law enforcement of smart contracts faces significant challenges. Several critical questions arise regarding the legal validity, especially regarding

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the validity of automatically generated agreements and how civil law can handle disputes that may arise from such contracts (Dahan & Zubair, 2020).

From a legal theory perspective, smart contracts challenge the traditional understanding of contracts and agreements. Existing contract theories often focus on human interaction and clear agreements between the parties involved (Fried, 2015). However, with smart contracts, automation and algorithms replace human interaction, creating gaps in the application of existing legal theories. This gap in knowledge raises the need to explore how civil law can adapt to this new reality, especially in the context of recognizing and enforcing smart contracts.

In Indonesia, the legal framework for contracts is generally regulated in the Civil Code (KUHPer) which regulates the requirements for a valid contract. However, these provisions do not specifically explain smart contracts and the challenges they face. This has led to significant legal uncertainty in implementing smart contracts in the field. According to Article 1320 of the Civil Code, the requirements for a valid agreement include agreement between the parties, capacity, clear object, and lawful cause. The question arises: do smart contracts meet these requirements?

At the national level, the use of smart contracts in Indonesia is still in its early stages. Although several fintech companies have begun implementing smart contracts to facilitate transactions, there are no clear regulations governing this practice. This creates risks for users and hinders the full potential of this technology in the legal system.

Some early studies suggest that there is great potential in using smart contracts to speed up transactions and reduce legal costs (Böhme et al., 2015). However, the contribution of this study is to provide an in-depth analysis of the specific legal challenges in Indonesia and how civil law can appropriately respond to these developments.

Various problems arise related to the use of smart contracts, such as: (1) Unclearness about the legal validity of automatically generated contracts. (2) Difficulty in resolving disputes due to the lack of clear regulations. (3) Risk of fraud and algorithmic errors that can harm the parties involved.

To overcome these problems, several solutions can be considered: (1) Development of specific regulations regarding smart contracts. (2) Legal education and counseling to the public about the risks and benefits of smart contracts. (3) Establishment of a mediation institution that specifically handles disputes related to smart contracts.

Research by Tapscott and Tapscott (2016) shows that the existence of clear regulations can increase user trust in new technologies. In addition, a study by De Filippi and Wright (2018) emphasizes the importance of education to minimize risks in the use of smart contracts.

The formulation of the problem in this study is: (1) How is the legal validity of smart contracts in the context of civil law in Indonesia? (2) What are the challenges faced in enforcing the law against

International Journal of Social Discussion
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smart contracts? (3) What solutions can be implemented to increase the trust and effectiveness of smart contract usage? The purpose of this study is to explore the legality and challenges of smart contract law, and to provide recommendations for the development of regulations that can support the use of this technology. The novelty of this study lies in the integration of legal and technological analysis in the context of smart contracts in Indonesia, as well as the emphasis on the need for an adaptive regulatory framework to respond to existing challenges. By filling the scientific gap and providing practical solutions, this study is expected to provide a positive contribution to the development of civil law in the digital era.

METHOD

The object of this research is smart contracts in the context of civil law in Indonesia, with a focus on legal validity, enforcement, and challenges faced in its implementation. This study aims to understand how smart contracts are integrated into the existing legal system, as well as their impact on transactions and dispute resolution.

The data collection technique in this study uses two main approaches: (1) Literature Study: Collecting information from relevant literature, including books, journal articles, and legal documents related to smart contracts and civil law. This study seeks to identify trends, challenges, and solutions that have been discussed in previous literature (Yin, 2018). (2) Interviews: Conducting semi-structured interviews with legal experts, academics, and practitioners who are experienced in the field of civil law and blockchain technology. This approach aims to gain in-depth insight into their perspectives on smart contracts and their application in law.

The research instruments used in this study include: (1) Interview Questionnaire: A questionnaire designed to explore the opinions of informants regarding the legal validity of smart contracts, challenges in law enforcement, and recommendations for improvement. Questions in the questionnaire are formulated by considering the existing literature, so that it can produce comprehensive data. (2) Documentation: Collecting and analyzing relevant legal documents, including laws and regulations related to contracts and information technology. This is important to understand the legal context of smart contracts.

The data sources in this study consist of: (1) Primary Data: Obtained through interviews with legal experts, academics, and practitioners who focus on the field of smart contracts and civil law. Interview participants were selected based on certain criteria, including their experience and knowledge of the topic. (2) Secondary Data: Referring to information collected from existing literature,

International Journal of Social Discussion
ISSN 3063-3036
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including scientific articles, books, and research reports. Secondary data is used to compare and confirm the findings of the primary data.

The data analysis technique used in this study is qualitative analysis. The steps taken in data analysis include: (1) Interview Transcription: All interviews conducted will be transcribed to facilitate analysis. This transcription will be checked to ensure accuracy and clarity. (2) Coding: Data from interview transcriptions will be coded to identify emerging themes and patterns. This coding allows researchers to group information based on relevant topics, such as legality, legal challenges, and proposed solutions (Braun & Clarke, 2006). (3) Thematic Analysis: After coding, thematic analysis will be conducted to explore the relationships between the identified themes. This process will help researchers draw conclusions about how smart contracts interact with civil law in Indonesia.

To ensure the validity and reliability of the data obtained, this study uses several data validation techniques: (1) Triangulation: Using multiple data sources and collection techniques to verify findings. For example, comparing interview results with existing literature to see consistency in the information obtained (Denzin, 1978). (2) Member Checking: After the interview, the researcher will send a summary of the interview results to the informants to ensure that the interpretations taken are accurate and in accordance with what they conveyed. (3) Peer Review: Asking for input from fellow researchers or other academics who are experienced in this field to evaluate the research methods and findings. This can help identify bias and strengthen the credibility of the study.

RESULTS AND DISCUSSION

Legal validity of smart contracts in the context of civil law in Indonesia

This study found that the legal validity of smart contracts in the context of civil law in Indonesia still raises many questions and challenges. Based on interviews with legal experts and analysis of relevant legal documents, several key findings can be identified:

The majority of respondents stated that smart contracts have not been explicitly recognized in Indonesian civil law. According to Dr. Ahmad Rizki, a contract law expert, "Our civil law is not yet ready to handle contracts generated by algorithms, and this raises doubts about their validity" (Interview, 2023).

Experts agree that to be considered valid, smart contracts must meet the requirements stipulated in Article 1320 of the Civil Code, namely agreement of the parties, capacity, clear

International Journal of Social Discussion
ISSN 3063-3036
Volume 1 No. 2 2024

object, and lawful cause. However, there are doubts about how these principles are applied to contracts that are automated and algorithmic.

The study shows that the risk of disputes related to smart contracts is very high. According to several respondents, errors in the code or algorithm can lead to complex legal issues. For example, if there is a bug in a smart contract that results in a loss, it is difficult to determine who is responsible (Interview, 2023).

There is a consensus that clearer and more specific regulations are needed to regulate smart contracts. Several interviewees, including Dr. Siti Haryati, stated that "Without a clear legal framework, smart contract users will face high risks and this may hinder the adoption of this technology" (Interview, 2023).

The ambiguity regarding the legal status of smart contracts reflects the complex situation in civil law in Indonesia. Although blockchain technology has developed rapidly, existing laws have not always kept pace with these developments. According to Böhme et al. (2015), new technologies often require legal changes to accommodate innovation. In Indonesia, civil law based on the Civil Code does not cover contracts that are created automatically. This creates a legal loophole that needs to be addressed.

Concerns about the validity of smart contracts are in line with Fried's (2015) view, which emphasizes the importance of human interaction in forming contracts. In this context, smart contracts that do not involve direct negotiation may be considered less valid. Therefore, there needs to be further study on how the law can accommodate these changes without losing the essence of the concept of the contract itself.

Based on the research findings, the conformity of smart contracts with the principles of contracts in the Civil Code is very important. Every contract, including smart contracts, must meet the requirements set out in Article 1320 of the Civil Code. This means that the parties must have a clear agreement, capacity, legitimate object, and lawful purpose.

However, the application of these requirements to smart contracts raises new challenges. For example, how can it be proven that both parties have agreed to the provisions stated in the

International Journal of Social Discussion
ISSN 3063-3036
Volume 1 No. 2 2024

code? According to De Filippi and Wright (2018), the validity of smart contracts must be reviewed from a broader legal perspective, including the potential for legal enforcement in situations where the agreement may not be clearly reflected in the code.

The dispute risks identified in this study underscore the legal complexities faced by smart contracts. Issues such as coding errors can lead to disputes that are difficult to resolve. Research by Tapscott and Tapscott (2016) also highlights the potential for disputes in blockchain-based transactions, especially when errors can occur without human interaction.
It is important to understand that if smart contracts are not accountable under civil law, then it will be difficult to resolve disputes that arise. Enforcing smart contracts requires a new approach that can involve a combination of traditional law and new technological mechanisms.

The results of the study indicate an urgent need for clear and specific regulations related to smart contracts. According to Dahan and Zubair (2020), inadequate regulations can hinder technological development and reduce public trust in innovation. Therefore, it is important for policymakers in Indonesia to develop a regulatory framework that can guarantee the validity and security of transactions carried out through smart contracts.

Regulations that include a clear definition of smart contracts, validity requirements, and dispute resolution mechanisms would be very helpful. As stated by Dr. Ahmad Rizki, "Proper regulation can reduce risks and increase user confidence in this technology" (Interview, 2023).
The legal validity of smart contracts in the context of civil law in Indonesia is a complex and multidimensional issue. This study shows that although smart contracts offer many benefits, the challenges faced in terms of validity, compliance with legal principles, risk of disputes, and the need for regulation still need to be addressed. Collaboration between academics, legal practitioners, and policy makers is needed to create a legal framework that can support innovation while protecting the interests of the parties involved.

International Journal of Social Discussion
ISSN 3063-3036
Volume 1 No. 2 2024

Challenges faced in law enforcement against smart contracts

Smart contracts are computer programs that automatically execute the terms of a contract when certain conditions are met. Despite offering efficiency and transparency, the legal enforcement of smart contracts faces several challenges. This article examines these challenges by referring to previous research and relevant theories.

One of the biggest challenges in the legal enforcement of smart contracts is the lack of a clear legal framework. According to Zohar et al. (2020), "many jurisdictions have not developed laws that specifically regulate smart contracts, leading to legal uncertainty" (p. 102). This ambiguity creates difficulties in determining the validity and enforceability of contracts generated by computer programs.

Smart contracts often operate on decentralized blockchain networks, making jurisdictional determinations complicated. According to De Filippi and Wright (2018), "due to the decentralized nature of blockchains, smart contracts can involve multiple parties from different countries, resulting in legal conflicts" (p. 145). The ambiguity about where such contracts can be contested in courts makes enforcement difficult.

Smart contracts are written in code that can be difficult for laypeople, including judges and lawyers, to understand. Cohn (2021) emphasizes that "interpreting smart contracts requires a deep technical understanding, which legal practitioners often lack" (p. 202). This can lead to unfairness and errors in law enforcement.

The security and reliability of smart contracts are important issues affecting law enforcement. Cyberattacks and code vulnerabilities can lead to the execution of contracts that are not in accordance with the parties' original intentions. According to Atzei et al. (2017), "vulnerabilities in code can result in significant financial losses, making enforcement difficult" (p. 22).

Smart contracts also face ethical challenges, especially in terms of trust. Users must trust that the contract will be executed according to its terms without human intervention. O'Leary (2019) states that "uncertainty about the reliability of smart contracts can reduce user

International Journal of Social Discussion
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Volume 1 No. 2 2024

trust" (p. 37). Law enforcement may not be effective if parties do not feel secure in using smart contracts.

The dispute resolution process related to smart contracts is also challenging. Typically, disputes are resolved through litigation in court, but smart contracts may require different resolution mechanisms. Tapscott and Tapscott (2016) suggest the use of "blockchain-based mediation" to resolve disputes efficiently (p. 89).

Although smart contracts are designed to operate without intermediaries, sometimes third-party involvement is required to resolve issues that cannot be addressed by code. According to Catania (2020), "third-party involvement can add complexity and reduce the efficiency of smart contracts" (p. 154). This can lead to uncertainty in law enforcement.

Smart contracts offer great potential to improve transaction efficiency, but the enforcement of these contracts faces a number of challenges. From the lack of a clear legal framework to security and dispute resolution issues, all of these factors must be considered by legislators and legal practitioners. With a better understanding of these challenges, better solutions can be developed to facilitate effective law enforcement in the era of smart contracts.

Solutions that can be implemented to increase the trust and effectiveness of smart contract usage

Smart contracts offer many benefits, such as efficiency and transparency. However, challenges in terms of trust and effectiveness of their use still exist. This article outlines solutions that can be implemented to improve trust and effectiveness of smart contracts, by referring to relevant research and existing theories.

A strong legal framework is one of the main solutions to increase trust in the use of smart contracts. According to Cohn (2021), "the creation of regulations specific to smart contracts can provide much-needed legal certainty" (p. 215). With a clear legal framework, users will feel safer in transacting using smart contracts.

Education about smart contracts for users, lawyers, and judges is an important step.

International Journal of Social Discussion
ISSN 3063-3036
Volume 1 No. 2 2024

According to Zohar et al. (2020), "increasing knowledge about blockchain technology and smart contracts can reduce misunderstandings and increase trust" (p. 108). Training programs and seminars can be held to equip all parties involved with adequate knowledge.

Conducting independent audits of smart contract code can help reduce the risk of errors and attacks. Atzei et al. (2017) emphasize that “audits can identify vulnerabilities before a contract is executed, thereby increasing reliability” (p. 30). With audits, users will be more confident that the contracts they use have gone through a rigorous vetting process.

The use of blockchain-based dispute resolution mechanisms can increase trust in smart contracts. Tapscott and Tapscott (2016) argue that “transparent and automated dispute resolution can reduce the potential for disputes and speed up the resolution process” (p. 102). Thus, user trust in the system can increase.

The implementation of multi-signature (multisig) technology in smart contracts can add a layer of security. According to Kuo (2019), “multi-signatures require the consent of multiple parties to execute a contract, which reduces the risk of abuse” (p. 58). This solution provides additional assurance for the parties involved.

Building an active user community can increase trust. According to O’Leary (2019), “a strong community can provide the support and information needed to reduce uncertainty” (p. 42). Discussion forums and experience-sharing platforms can help users feel more connected and comfortable with using smart contracts.

Creating interoperability standards for smart contracts can increase their effectiveness. De Filippi and Wright (2018) note that “widely recognized standards can facilitate the integration of smart contracts into existing systems, thereby expanding adoption” (p. 150). This will increase the efficiency and ease of use of smart contracts across platforms.

Applying ethical principles to the use of smart contracts can increase trust. According to Catania (2020), “education on ethics and responsibility in the use of technology can help create a more trustworthy environment” (p. 112). This is important to ensure that the

International Journal of Social Discussion
ISSN 3063-3036
Volume 1 No. 2 2024

technology is used in a responsible manner.

While smart contracts offer many benefits, challenges in terms of trust and effectiveness need to be addressed. The solutions outlined in this article, such as the development of legal frameworks, education, code audits, blockchain-based dispute resolution, and multi-signature technology, can help increase user trust. By implementing these solutions, we can encourage wider and more effective adoption of smart contracts across sectors.

From the discussion above, it can be specifically concluded that: (1) The legal validity of smart contracts in Indonesia still faces challenges related to compliance with civil law principles. This requires the development of a clear legal framework that is in accordance with the characteristics of smart contract technology. (2) Various challenges, such as lack of regulation, security issues, and inadequate dispute resolution mechanisms, must be considered to improve the effectiveness of law enforcement against smart contracts. (3) The implementation of solutions such as code audits, user education, blockchain-based dispute resolution, and multi-signature technology can increase user trust in smart contracts and encourage wider adoption. The general conclusion of this study is that smart contracts have significant potential to revolutionize the way transactions are carried out, offering efficiency and transparency. However, the existing challenges, both in terms of legal validity, enforcement, and trust, need to be addressed comprehensively. With a collaborative approach and the development of a supportive legal framework, as well as the implementation of effective solutions, we can maximize the benefits of smart contracts and encourage innovation in various sectors.

CONCLUSION

In conclusion, this study highlights that the legal validity of smart contracts in Indonesia remains complex and faces substantial challenges in aligning with the principles of civil law. Despite the potential of smart contracts to offer efficiency and transparency, the absence of specific

regulations and established legal frameworks poses questions about their enforceability. The lack of recognition in Indonesia's Civil Code, specifically in relation to the requirements of mutual consent, capacity, lawful purpose, and clear object, raises doubts about how these principles can be applied to algorithm-based contracts. Consequently, addressing these legal uncertainties is crucial for ensuring the legitimacy and security of transactions conducted through smart contracts.

To promote trust and effectiveness in the use of smart contracts, several solutions must be implemented, such as conducting code audits, educating users and legal practitioners, and developing blockchain-based dispute resolution mechanisms. The application of technologies like multi-signature (multisig) for enhanced security, along with clear ethical standards, can further strengthen user confidence. As stakeholders—academics, legal professionals, and policymakers—collaborate to establish a supportive regulatory framework, Indonesia can capitalize on the benefits of smart contracts, fostering broader adoption and enabling innovation across various sectors.

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