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The Role of Blockchain Technology in Improving Security and Transparency of Financial Transactions in Indonesia

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Abstract: *Blockchain technology has developed rapidly in recent years and is considered a promising solution for increasing security and transparency in financial transactions. Originally developed to support cryptocurrencies such as Bitcoin, blockchain is now being applied across various sectors, including banking and finance. This paper explores the role of blockchain technology in improving financial transaction systems, focusing on its ability to enhance security and transparency, thereby boosting user trust. It also examines the application of blockchain in Indonesia's financial sector, highlighting both the challenges and opportunities the country faces in adopting this technology. The methodology used in this study includes a qualitative analysis of existing literature on blockchain technology, case studies of its implementation in global financial systems, and an assessment of the regulatory landscape in Indonesia. The paper also discusses interviews with industry experts and stakeholders to gather insights into the practical challenges of blockchain adoption in the Indonesian financial sector. This research concludes with an analysis of blockchain's potential to revolutionize the global financial system, offering recommendations for its successful integration into Indonesia's financial ecosystem.*

Introduction

The rapid development of information technology in the digital era has influenced various sectors, including the financial sector. One of the

key innovations that has garnered significant attention is blockchain technology. Blockchain is a system that enables data to be stored in the form of blocks, which are linked in a chain and cannot be altered (immutable), creating a highly transparent and secure transaction process (Nakamoto, 2008; Tapscott & Tapscott, 2016). This technology can be applied in various sectors, with financial transactions being one of its most promising applications (Catalini & Gans, 2016). In Indonesia, the financial sector faces challenges such as lack of transparency, risk of fraud, and high transaction costs. Many financial transactions, both between individuals and institutions, still rely on manual processes and require third-party intermediaries, such as banks or other financial institutions (Böhme et al., 2015). This paper explores how blockchain can overcome these issues by enhancing security and transparency in financial transactions. By employing a qualitative approach, this research evaluates the potential of blockchain in transforming the Indonesian financial sector and contributing to the broader global financial system.

The rapid development of information technology in the digital era has influenced various sectors, including the financial sector. One of the key innovations that has garnered significant attention is blockchain technology. Blockchain is a system that enables data to be stored in the form of blocks, which are linked in a chain and cannot be altered (immutable), creating a highly transparent and secure transaction process (Nakamoto, 2008; Tapscott & Tapscott, 2016). This technology can be applied in various sectors, with financial transactions being one of its most promising applications (Catalini & Gans, 2016). In Indonesia, the financial sector faces challenges such as lack of transparency, risk of fraud, and high transaction costs. Many financial transactions, both between individuals and institutions, still rely on manual processes and require third-party intermediaries, such as banks or other financial institutions, resulting in inefficiencies and increased costs (Wicaksono, 2018; Puspitasari & Lestari, 2020). This paper explores how blockchain can overcome these issues by enhancing security and transparency in financial transactions. By

employing a qualitative approach, this research evaluates the potential of blockchain in transforming the Indonesian financial sector and contributing to the broader global financial system. This not only increases costs but also reduces efficiency. For this reason, the application of blockchain in the financial sector is considered to be a solution to increase security, transparency and efficiency of financial transactions in Indonesia.

Blockchain is the technology underlying decentralized systems, allowing data to be recorded and verified without involving a central third party. In the context of financial transactions, blockchain facilitates safer transactions because each transaction is recorded in the form of an encrypted block, and each block is linked to the previous block in a chain that forms a transparent and unchangeable "ledger".

Some of the main characteristics of blockchain technology are: 1) Decentralization; No single party controls the entire blockchain network. This reduces the potential for fraud and data leaks. 2) Security; Every transaction that occurs in the blockchain is verified using cryptographic algorithms that make the data difficult to manipulate. 3) Transparency; All participants in a blockchain network have a complete copy of the transactions that occur, providing full visibility into the transactions that occur. 4) Openness and Ease of Access; All parties who have permission can verify and access transaction data.

The Indonesian financial sector faces several quite complex problems, including: 1) Limited Transparency; Many financial transactions carried out in Indonesia are not completely transparent, both in terms of fund management and the transaction verification process. 2) Vulnerable Transaction Security; Financial transactions that rely on traditional systems are vulnerable to the threat of hacking and data manipulation. The third party involved is often the weak point. 3) High Transaction Fees; Transactions between financial institutions or individuals involving third parties are often subject to high fees that reduce profits or user efficiency. 4) Slow Transaction Process; Some types of transactions, especially cross-

border ones, can take a long time and involve many stages that slow down the flow of funds.

The use of blockchain technology can be a solution to overcome existing problems in the Indonesian financial system. Several steps that can be taken to implement blockchain in the financial sector in Indonesia include: 1) Implementation of Blockchain in Payment Systems; Using blockchain to simplify payment transactions between individuals and institutions without the need for a third party. This can reduce transaction costs and speed up the payment process. 2) Implementation of Smart Contracts; Smart contracts are programs that can execute transactions automatically when certain conditions are met. This can increase efficiency and reduce dependence on third parties in financial transactions. 3) Blockchain Infrastructure Development; Infrastructure development that allows blockchain to be widely used by banks, financial institutions and Indonesian society. This could include developing blockchain-based platforms for digital financial transactions, payments and investments. 4) Education and Technology Literacy; Increase public and financial sector players' understanding of blockchain technology to maximize its potential, as well as reduce uncertainty regarding this new technology.

A number of studies have examined the use of blockchain technology in the financial sector. For example, a study conducted by Tapscott and Tapscott (2016) in their book Blockchain Revolution explains how blockchain can increase transparency, efficiency, and trust in the global financial system. Another study by Catalini and Gans (2016) highlights the benefits of blockchain technology in reducing transaction costs and increasing the security of cross-border payments.

Research conducted in Indonesia shows the potential of blockchain technology to increase financial inclusion by enabling more people to access financial services digitally, especially in regions not yet covered by conventional banking systems (Ismail, 2020). Furthermore, a study by Yulianto and Handayani (2021) reveals that blockchain's application in the

financial sector can reduce operational costs and enhance the security and transparency of transactions. Blockchain technology offers enormous potential to improve security, transparency, and efficiency in the financial transaction sector in Indonesia. By addressing problems such as high costs, slow processes, and vulnerable security, blockchain can pave the way for a more efficient, secure, and reliable financial system. Through the proper application of blockchain, Indonesia's financial sector can be more advanced, safer, and more inclusive.

However, despite these promising findings, there is a significant gap in the literature concerning how blockchain can be effectively integrated into Indonesia's unique financial, regulatory, and technological landscape. While previous studies have highlighted blockchain's potential, they have largely focused on the technological aspects without addressing the practical challenges related to implementation at a national level. This research is motivated by the need to explore how blockchain technology can overcome these existing challenges and gaps, particularly in terms of infrastructure, regulation, and accessibility. The study aims to fill this gap by examining the barriers to adoption, the regulatory environment, and the potential impacts of blockchain on financial inclusion, operational costs, and overall security within Indonesia's financial system.

Understanding Blockchain Technology

Blockchain is a technology that allows data to be stored in the form of sequentially connected blocks (chains) using a decentralized system. Each block contains encrypted information, and the data in the blockchain cannot be changed after the transaction occurs. In general, blockchain functions as a distributed ledger that does not rely on a single entity or third party to verify transactions (Nakamoto, 2008). This technology was first used by Bitcoin to support cryptocurrency transactions, but in its development, blockchain has wider potential in various sectors, including the financial sector.

Key Characteristics of Blockchain

There are several underlying characteristics of blockchain technology, which make it relevant in improving the security and transparency of financial transactions:

1. Decentralization: Blockchain does not require a central authority such as a bank or other financial institution to validate transactions. Instead, a globally distributed network of computers work together to verify each transaction (Narayanan et al., 2016). This reduces the risk of manipulation or fraud that can occur in a centralized system.
2. Security: Every transaction recorded in the blockchain uses a strong cryptographic algorithm, making the data difficult to manipulate or change. In addition, each transaction is monitored and verified by network participants, increasing data integrity (Atzori, 2017).
3. Transparency: Blockchain creates a system that is accessible to all participants in the network, allowing for greater transparency into every transaction that occurs. All authorized parties can view the transaction history recorded in the blockchain openly, thereby increasing trust between parties (Tapscott & Tapscott, 2016).

Blockchain in the Financial Sector

In the financial sector, blockchain technology is considered a potential solution to improve the efficiency, transparency, and security of transactions. In traditional systems, financial transactions often involve many different parties (such as banks, clearing houses, etc.) which causes high transaction costs, and takes a long time to complete the transaction verification process (Catalini & Gans, 2016). Blockchain can reduce dependence on these third parties, thereby speeding up and lowering transaction costs. Specifically, blockchain can be applied in various aspects of the financial sector, such as:

1. Digital Payments: Blockchain can be used to facilitate cross-border payments at low costs and faster processes compared to conventional

methods (Narayanan et al., 2016). For example, this technology can reduce interbank transfer fees that are often charged in international transactions.

2. Smart Contracts: In blockchain, smart contracts are programs that can execute agreements or transactions themselves after previously agreed conditions are met. This allows automation in the financial transaction process, which reduces human error and increases efficiency (Buterin, 2014).
3. Digital Asset and Tokenization: Blockchain also enables the creation of digital assets and tokenization, which provides new opportunities for investment and ownership of assets in digital form. In Indonesia, this sector can drive financial inclusion for people who do not have access to traditional banking services (Zohar, 2019).

Security in Blockchain

One of the main advantages of blockchain technology is its high level of security. Every transaction recorded in the blockchain is processed and verified by many nodes in the network before being included in the block. This reduces the potential for data manipulation or hacking that can occur in a centralized system (Crosby et al., 2016). In addition, the encryption techniques used in blockchain ensure that transaction data cannot be changed or stolen without being detected. The use of this technology in the financial sector can reduce the risk of fraud and increase public trust in the digital financial system.

Transparency in Blockchain

Blockchain can also increase transparency in financial transactions. As an open system, blockchain allows all parties involved in a transaction to see the complete transaction history. This prevents the occurrence of ambiguity or fraud that often occurs in traditional, more closed systems (Peters & Panayi, 2016). By using blockchain, parties involved in a transaction can verify that each transaction is recorded correctly and that no information is hidden. In addition, the audit process becomes easier to

do, because every step of the transaction can be tracked in a distributed ledger.

Blockchain in Indonesia

In Indonesia, the application of blockchain in the financial sector has great potential. Several financial institutions in Indonesia have begun to adopt this technology to improve the efficiency and security of their services. Bank Indonesia has conducted trials of the use of blockchain in payment systems, while several fintechs and startups are also utilizing this technology to provide more transparent and affordable financial services (Ismail, 2020). However, although the potential of blockchain is enormous, challenges related to regulations and infrastructure that are not yet fully ready are still obstacles to its implementation.

Challenges and Prospects of Blockchain in Indonesia

Although blockchain offers various benefits, the implementation of this technology in Indonesia still faces challenges. One of the main challenges is the absence of clear regulations related to the use of blockchain in the financial sector. In addition, low digital literacy and lack of understanding of this technology among the public and industry players are also significant obstacles. However, with the continued development of technological infrastructure and increasing understanding of blockchain, Indonesia has the potential to become one of the countries that utilizes this technology optimally in the financial sector (Yulianto & Handayani, 2021).

Research Methods

This study employs a qualitative research methodology combining three main approaches: a qualitative approach, a literature study, and expert interviews. The qualitative nature of this research enables an in-depth understanding of the perceptions, challenges, and opportunities related to the adoption and implementation of blockchain technology in Indonesia's financial sector. Data is gathered from various sources to explore how

blockchain can enhance security and transparency in financial transactions. Furthermore, this study analyzes real-world examples of blockchain applications within the Indonesian financial system to provide practical insights.

In research that focuses on the application of blockchain technology in the financial sector, the methodology used is very important to obtain a deep and comprehensive understanding of the topic. This methodology consists of a qualitative approach, a literature approach, and interviews. The following is a discussion of each approach in this research methodology:

Qualitative Approach

A qualitative approach is used to dig up in-depth information about the phenomenon being studied. This approach focuses more on understanding the context, experience, perceptions, and views of the parties involved in the application of blockchain in the financial sector. In this study, the qualitative approach aims to identify various factors that influence the adoption and implementation of blockchain in the financial system in Indonesia. Steps in Qualitative Approach:

a. Data Collection: Data is collected through various sources, such as in-depth interviews, observations, and focus group discussions with various stakeholders (banks, fintech, regulators, and blockchain technology experts).
b. Data Analysis: Data analysis is carried out by categorizing and identifying patterns that emerge in conversations and information obtained. Thematic analysis techniques are often used to compile and understand qualitative findings.
c. Objectives: This qualitative approach helps researchers understand the perceptions, barriers, and opportunities that exist in the application of blockchain in the financial sector, especially in Indonesia.

Literature Approach

The literature approach is a method that relies on the study of various relevant literature or references to understand and analyze a phenomenon. In this study, the literature approach is used to explore previous theories and studies on blockchain technology, its application in the financial sector, as well as its challenges and benefits. Steps in the Literature Approach:

a. Source Search: Researchers search for and collect articles, books, research reports, and academic journals that discuss blockchain in the financial sector, both in Indonesia and abroad.
b. Source Analysis: After the literature data is collected, an analysis is carried out to find trends, key findings, and research gaps in the topic discussed.
c. Objectives: This approach aims to build a strong theoretical foundation, provide context to previous research findings, and help formulate a framework for thinking in the research being conducted

Interview

Interview is a data collection method that involves direct interaction between researchers and informants to obtain more in-depth information about the research topic. In this study, interviews were conducted with experts in the blockchain field, financial industry players, and parties involved in the development of technology policies in Indonesia. Steps in the Interview:

a. Informant Selection: Informants are selected based on their relevance and expertise criteria, such as officials from Bank Indonesia, representatives from financial institutions, fintech entrepreneurs, or academics who have in-depth knowledge of blockchain.
b. Interview Design: Interviews can be conducted with open-ended or semi-structured questions that allow researchers to dig deeper into information according to the research theme.

c. Interview Implementation: Interviews can be conducted face-to-face, by telephone, or digital platforms such as Zoom, depending on the convenience and availability of the informants.
d. Interview Data Analysis: Data obtained from interviews is analyzed to find certain themes or patterns that emerge from the perspectives of the informants. This analysis can be done using methods such as thematic analysis or content analysis.

Result and Discussion

Blockchain Adoption Rate in Indonesia's Financial Sector

Research results by Bank Indonesia (2023) show the adoption of blockchain technology by financial institutions. The results show that 33% of banks in Indonesia have started implementing blockchain technology in several product and service lines, especially in cross-border payment and transaction systems. The following is blockchain adoption data from Bank Indonesia's research:

Table 1. Block Chain Adoption

No	Statement	Persentage
1	Financial institutions implement blockchain to improve efficiency	33%
2	Financial institutions are testing blockchain for further applications	50%
3	Financial institutions have not yet considered implementing blockchain	17%

Source: Bank Indonesia, 2023

Bank Indonesia's findings state that 33% of financial institutions implement blockchain to improve efficiency in several of their product and service lines. The main focus of this adoption is on cross-border payment and transaction systems. Blockchain technology enables faster, cheaper, and more secure transactions, which are essential in international transactions that often involve high costs and complicated verification processes. By implementing blockchain, banks can reduce the time it takes to complete transactions and minimize dependence on third parties, which

often slow down the process. In addition, blockchain implementation also allows financial institutions to increase transparency in every transaction. All transactions made will be permanently recorded in a distributed ledger and can be accessed by all parties involved, reducing the potential for fraud or data manipulation. This is in accordance with the characteristics of blockchain which has advantages in terms of data security and integrity.

The results of Bank Indonesia's research also showed that half of the respondents (50%) stated that they were testing the implementation of blockchain for further applications. This shows that although blockchain adoption in Indonesia is increasing, many financial institutions are still at the exploration and testing stage. Blockchain testing generally aims to better understand the potential and challenges that exist, and to assess whether this technology can really provide significant benefits in their operations.

This testing stage also reflects the caution of financial institutions in adopting new technologies that may require major changes in existing infrastructure and systems. Therefore, these institutions choose to conduct trials first to identify potential problems and assess the readiness of their systems to fully adopt blockchain technology.

The results of the study also show that 17% of financial institutions in Indonesia have begun to consider or even implement blockchain technology. There are several reasons underlying this decision, including:

a. Limited Knowledge and Resources: Some financial institutions may not have sufficient understanding of blockchain or feel unprepared in terms of human resources and technology to make the change.
b. Concerns about Regulation and Security: Blockchain is a relatively new technology in Indonesia, and some financial institutions may be concerned about unclear regulations or data security issues related to the implementation of this technology.

c. Infrastructure Readiness: The infrastructure needed to implement blockchain effectively may not yet be available or adequate for these institutions, causing them to delay the adoption of this technology.

This study shows that although blockchain adoption in Indonesia is still relatively early, there is a positive trend in the implementation of this technology. Some implications that can be drawn from the results of this study include:

a. Potential to Increase Efficiency and Reduce Costs

   Blockchain can help financial institutions reduce operational costs and the time it takes to process transactions. For example, in cross-border transactions, blockchain can reduce high transfer fees and speed up transaction settlement times, which will greatly benefit financial institutions and their customers. Thus, blockchain adoption can provide greater competitiveness for financial institutions that implement it.

b. Challenges in Large-Scale Implementation

   Although 33% of financial institutions have implemented blockchain, the main challenge for them is integrating this technology on a larger scale and involving more products or services. This requires a large investment in infrastructure and system development that supports blockchain. In addition, education and training for human resources are also very necessary to ensure successful implementation.

c. The Importance of Supportive Regulations

   One factor that can accelerate blockchain adoption in Indonesia is the existence of clear and supportive regulations. Without clear guidelines from the relevant authorities, financial institutions may hesitate to invest heavily in this technology. Therefore, Bank Indonesia and other authorities need to accelerate the creation of regulations that provide legal guarantees and facilitate wider blockchain adoption.

d. Development of Deep Technology Infrastructure

Adequate technology infrastructure is essential to support blockchain implementation in the financial sector. Therefore, it is important for financial institutions and the government to work together to increase infrastructure capacity, both in terms of hardware and software, to ensure the successful adoption of blockchain technology.

Security and Transparency in Financial Transactions

Report from the Financial Services Authority (OJK) 2022: OJK conducted a survey on the application of blockchain technology in terms of security and transparency. From the results of a survey conducted on 100 financial institutions in Indonesia, 80% stated that the implementation of blockchain has increased the transparency of financial transactions. In addition, 75% of financial institutions reported a significant reduction in the risk of fraud and cheating after adopting a blockchain-based system. Meanwhile, the statement of banks considering blockchain to be able to prevent data manipulation in transactions shows that 60% of financial institutions in Indonesia agree with this. The following are the findings of the security and transparency data study after using blockchain:

Table 2. Security and Transparency Data

No	Statement	Persentage
1	Institutions feel there is an increase in transparency	80%
2	Feel a decrease in the risk of fraud and cheating	75%
3	Banks consider blockchain to be able to prevent data manipulation in transactions	60%

Source: Financial Services Authority, 2022

This survey was conducted by the Financial Services Authority (OJK) on 100 financial institutions in Indonesia. The results of the survey on financial institutions show that 80% of blockchain usage is able to increase transparency in financial transactions. This is because blockchain as a distributed ledger system allows every transaction to be permanently

recorded in an open ledger and can be accessed by all parties with permission. The existence of this transparent record ensures that transactions cannot be changed or manipulated without being detected. This also shows that the implementation of blockchain is clearer and more accurate regarding the flow of funds and transaction activities. This increased transparency provides a number of benefits, including:

a. Increasing Public Trust: With greater transparency, the public and customers feel more confident in financial institutions that use blockchain, because they can verify transactions made without having to rely entirely on third parties.
b. Prevention of Abuse: Because every transaction can be seen by authorized parties, abuse or fraud committed by internal or external parties will be more easily detected. This reduces the risk of fraud and increases the reliability of the financial system as a whole.

As many as 75% of financial institutions surveyed reported a significant decrease in the risk of fraud and cheating after implementing blockchain. This can be explained by the characteristics of blockchain which is secure and cannot be manipulated. Given that every transaction made must go through a strict verification process by many parties in the network (including validators and other nodes). Some of the reasons why blockchain is able to reduce the risk of fraud and cheating include:

a. Cryptographic Security: Blockchain uses strong encryption to ensure that data recorded in the system cannot be changed or accessed without permission. This reduces the potential for fraud involving data manipulation or illegal withdrawal of funds.
b. Decentralization: In a decentralized system, no single party has full control over the entire network. Thus, the risk of fraud from a single party with power (for example, a bank or large financial institution) can be minimized.
c. Multi-Party Verification: Every transaction made within the blockchain network must be verified by many nodes in the network.

If there is an attempt at data manipulation or fraud, the system will reject it because the verification carried out by many parties will detect any discrepancies.

In addition, the results of the OJK study also show that around 60% of banks surveyed feel that blockchain has the ability to prevent data manipulation in transactions. Blockchain relies on cryptographic techniques that ensure that recorded data cannot be changed afterwards without damaging the integrity of the entire system. Once data is entered into a block, any changes will affect the entire network and can easily be detected by other validators, making data manipulation almost impossible. Factors that support the prevention of data manipulation in blockchain include:

a. Immutability: Every transaction recorded in the blockchain cannot be changed or deleted. If someone tries to change the data in one block, it will cause changes to the entire next block, which will be immediately known to the entire network.
b. Use of Consensus: In blockchain, consensus from many parties is required to validate transactions, which makes data manipulation more difficult. This consensus ensures that the recorded data has been verified by many parties before being considered valid.
c. Strengthening Data Security: Because blockchain uses various encryption methods and verification mechanisms, the data recorded in it is much safer compared to traditional systems that are more vulnerable to hacking or data manipulation.

Based on the results of a survey conducted by OJK, the implementation of blockchain has had a major positive impact on the financial sector in Indonesia, especially in terms of increasing transparency and reducing the risk of fraud. Some of the implications of these findings are as follows:

a. Increasing Public Trust in the Financial System

With increased transparency and reduced risk of fraud, the public will feel safer and more confident in transacting with financial institutions that implement blockchain technology. This can encourage greater financial inclusion, with more people choosing to use formal financial services.

b. Operational Efficiency and Cost Reduction

Blockchain reduces the need for verification processes that require many parties in financial transactions. With decentralization and automation through smart contracts, financial institutions can minimize operational costs associated with transactions and administration. This allows them to offer more efficient services and lower costs to customers.

c. Increased Security and Reduced Operational Risk

Blockchain provides stronger protection against operational risks, such as data manipulation, fraud, or hacking. This security is very important, given the increasing threats to the digital financial system, which can harm customers and financial institutions themselves.

d. The Importance of Clear Regulatory Support

To ensure that blockchain implementation can run smoothly, supportive and clear regulations are needed regarding its use in the financial sector. OJK as a regulator must continue to develop policies that facilitate the adoption of this technology by prioritizing security and protection for consumers.

Barriers and Challenges to Blockchain Implementation

A survey by the Indonesian Fintech Association (AFI) in 2023 showed that although many financial institutions in Indonesia are interested in adopting blockchain, some of the main challenges they face include the lack of supporting infrastructure and lack of knowledge and understanding of blockchain. The survey results showed that around 45% of fintech companies stated that they still face major challenges in terms of

regulation and legal uncertainty related to the implementation of this technology.

No	Statement	Persentage
1	Fintech companies identify regulation as the main challenge	45%
2	Financial institutions consider technological infrastructure as the main obstacle	40%
3	Companies report limited human resources trained in blockchain	30%

Source: Indonesian Fintech Association, 2023

A survey conducted by the Indonesian Fintech Association (AFI) in 2023 provides a clear picture of the challenges faced by financial institutions, especially fintech companies, in implementing blockchain technology in Indonesia. As many as 45% of fintech companies identify regulation as the main challenge in implementing blockchain technology. One of the main reasons why regulation is an obstacle is because blockchain technology is still relatively new in Indonesia, and existing regulations are not yet clear or adequate to support the full implementation of this technology. Some of the regulatory issues faced by fintech companies include:

a. Legal Uncertainty: Without clear regulations, fintech companies are hesitant to make large investments in blockchain technology because they are worried about sudden policy changes or uncertainty in the implementation of the law.
b. Lack of Guidelines: The absence of clear guidelines from the government or financial authorities regarding the use of blockchain in the financial system can slow down the adoption of this technology. This has the potential to cause confusion for financial institutions that want to adopt it legally and safely.
c. Difficulty in Compliance: Financial institutions operating in Indonesia need to ensure that they comply with all applicable regulations. If blockchain regulations have not been properly drafted,

they may have difficulty integrating this technology with existing systems without violating applicable regulations.

The research results also show that 40% of financial institutions surveyed consider technological infrastructure to be the main obstacle in implementing blockchain. The infrastructure referred to here includes various elements, from hardware that supports blockchain technology to software systems that can operate efficiently with the technology. Challenges that arise related to infrastructure include:

a. Limited Digital Infrastructure: Digital infrastructure in Indonesia, although developing rapidly, is still uneven, especially in more remote areas. Some financial institutions may face difficulties in obtaining adequate infrastructure to support optimal blockchain implementation.
b. High Implementation Costs: Implementing blockchain technology on a large scale requires significant investment in hardware and software. This can be a major burden for financial institutions, especially those with limited budgets.
c. Sustainable Infrastructure Expansion: Blockchain is a technology that requires a global network and very large processing capacity. Therefore, financial institutions must update and develop their infrastructure in order to take full advantage of this technology.

Another finding is that around 30% of fintech companies reported that the lack of human resources trained in blockchain technology is one of the main challenges in implementing this technology. Although interest in blockchain is increasing, the lack of a workforce with sufficient skills and knowledge to implement and manage blockchain effectively is a major obstacle. Some of the factors underlying this obstacle are:

a. Lack of Specialized Education and Training: Blockchain is a complex and new technology, and many professionals in the financial sector still do not have in-depth knowledge of how it works. Therefore,

financial institutions need special training to develop the skills of their human resources in terms of blockchain.

b. Challenges in Finding Experts: The demand for skilled workers in the blockchain field is very high, but the supply of workers with these skills is still limited. This makes it difficult for financial institutions to recruit experts who can support the implementation of blockchain technology.
c. The Need to Increase Digital Literacy: In order to be able to take full advantage of blockchain technology, financial institutions need a workforce that is not only trained in blockchain itself, but also has a broader understanding of digital technology and financial innovation in general.

Solutions to overcome these barriers include providing more and more affordable training programs in blockchain, as well as collaboration between the financial sector, educational institutions, and the government to strengthen human resource capabilities in this field. The barriers to blockchain implementation certainly have implications, such as:

a. Supportive Regulation for Innovation

   To encourage wider blockchain adoption, it is important for governments and regulators to accelerate the development of clear regulations that support innovation, so that fintech companies can operate within a safe and predictable legal framework.

b. Building Better Digital Infrastructure

   Adequate infrastructure is critical to the success of blockchain implementation. Therefore, the government and the private sector need to work together to build and update digital infrastructure to support blockchain technology, especially in areas that do not yet have sufficient access to technology.

c. Improving the Quality of Human Resources

Improving the capacity of human resources is key to effective blockchain adoption. Fintech companies and financial institutions need to invest more in training and developing the skills of their workforce in blockchain technology and related digital technologies.

Development of Blockchain Regulation in Indonesia

The Ministry of Finance of the Republic of Indonesia (2023) stated that they are currently formulating clearer regulations regarding the use of blockchain in the financial sector, including the use of cryptocurrency and smart contracts. However, fintech companies in Indonesia hope that the government can immediately issue more concrete regulations regarding the implementation of blockchain and the legal use of cryptocurrency. Here it is:

No	Statement	Persentage
1	Companies hope for clearer regulations from the government.	60%
2	Respondents feel that the current regulations are still ambiguous and confusing	35%
3	Companies feel that the regulations are adequate	5%

Source: Respondents' Responses to the Statement of the Ministry of Finance 2023, 2024

The statement by the Ministry of Finance of the Republic of Indonesia that they are currently formulating clearer regulations regarding the use of blockchain technology in the financial sector, including cryptocurrency and smart contracts, shows that the Indonesian government is beginning to understand the importance of more mature regulations regarding this technology.

However, even though the government is currently designing the regulations, survey results show that most fintech companies in Indonesia feel that the existing regulations are still unclear and inadequate. The survey results revealed that 60% of fintech companies expect more concrete regulations to be issued by the government soon, while 35% of companies

feel that the current regulations are still ambiguous and confusing, and only 5% feel that the regulations are adequate. Based on this data, it can be concluded that despite the great desire for blockchain adoption, uncertainty regarding regulations is a major obstacle for companies that want to move forward in implementing this technology.

The findings of 60% of fintech companies surveyed expect the government to immediately issue clearer regulations regarding the implementation of blockchain and the legal use of cryptocurrency. Without clear regulations, fintech companies feel hampered in taking strategic steps to implement blockchain technology, both in terms of operations and in developing new products. Some of the reasons why clear regulations are very important include:

a. Increasing Legal Certainty: Clear regulations will provide legal assurance to fintech companies that they can operate safely and in accordance with applicable regulations, thereby reducing legal risk.
b. Encouraging Investment: Clarity of regulations can increase investor confidence in the fintech sector, because they can see that the market has clear and stable rules. This is important to support the growth of a larger fintech ecosystem.
c. Supporting Guided Innovation: With clear regulations, fintech companies can more easily develop and implement blockchain technologies such as cryptocurrencies and smart contracts, because they know what is allowed and what is not.

The results of the study also showed that around 35% of fintech companies feel that the current regulations are still ambiguous and confusing. This ambiguity can be a major obstacle in the implementation of blockchain technology, because fintech companies often do not know whether they are violating existing rules or not. Regulatory ambiguity can cause several problems, including:

a. Confusion in Compliance

   Fintech companies that want to implement blockchain and cryptocurrency must ensure that they comply with applicable regulations. If the regulations are ambiguous, they may worry that the products or services they offer may violate the law, even if they have followed best practices in the industry.

b. Risk of Non-Compliance with Regulations

   Without clarity, financial institutions may avoid adopting blockchain technology due to uncertainty about whether their actions will be considered legally valid. This ambiguity can also lead to potential legal risks for companies.

Meanwhile, only 5% of companies feel that existing regulations are adequate. This shows that a small portion of fintech companies are comfortable with the current regulatory environment. Although a small portion of companies feel that regulations are adequate, this could indicate that more experienced or larger companies may already have a better understanding of how to navigate existing regulations. Some Implications of the Survey Results are:

a. The Need for Fast and Clear Regulations

   The survey results show that the fintech industry in Indonesia is eagerly awaiting more concrete and clear regulations regarding the use of blockchain and cryptocurrency. To encourage the growth of the fintech sector and minimize the risk of legal uncertainty, it is important for the government to immediately formulate and issue regulations that support innovation, while still maintaining consumer security and protection.

b. Legal Certainty to Support Technology Adoption

   Regulatory clarity will provide legal certainty for fintech companies and financial institutions that want to implement blockchain technology. Clear regulations will help reduce legal risks and allow

companies to develop blockchain-based products and services with more confidence.

c. The Role of Government in Supporting Innovation

To accelerate the adoption of blockchain technology, the government needs to play an active role in providing a regulatory framework that can support innovation without hindering industry growth. Collaboration between regulators and fintech industry players will be very helpful in formulating effective and efficient regulations.

Conclusion and Recommendations

Conclusion

Blockchain technology has great potential in improving the security and transparency of financial transactions in Indonesia. In recent years, the Indonesian financial sector has begun to see the real benefits of implementing blockchain, especially in strengthening the payment system, increasing efficiency, and reducing the risk of fraud and data manipulation. Based on various studies and surveys conducted by Bank Indonesia, the Financial Services Authority (OJK), the Indonesian Fintech Association (AFI), and the Ministry of Finance, it can be concluded that:

1. Security and Transparency: The implementation of blockchain technology has been proven to increase the transparency of financial transactions. As many as 80% of financial institutions surveyed by OJK stated that blockchain increases transparency, while 75% reported a significant decrease in the risk of fraud and cheating. This shows that blockchain has made a positive contribution to strengthening the integrity and security of the financial transaction system in Indonesia.
2. Growing Adoption: Many financial institutions in Indonesia have begun to adopt blockchain. Based on a survey by Bank Indonesia, 33% of banks have implemented blockchain in several product and service

lines, and another 50% are testing this technology for further applications. This reflects the great interest in integrating blockchain into various financial sectors, especially in cross-border payment and transaction systems.

3. Implementation Barriers: Although the potential of blockchain technology is great, there are several barriers to its implementation, including the lack of supporting infrastructure, lack of knowledge about blockchain, and regulatory challenges. The AFI Survey (2023) shows that 45% of fintech companies identify regulation as the main challenge, and another 40% consider technology infrastructure to be the biggest obstacle.
4. Need for Clear Regulation: Many fintech companies want clearer regulations regarding the implementation of blockchain, cryptocurrency, and smart contracts. The survey shows that 60% of companies hope for more concrete regulations to provide the legal certainty needed to encourage wider adoption. Without adequate regulations, the potential for blockchain innovation could be hampered by legal uncertainty.

Recommendations

To maximize the potential of blockchain technology in improving the security and transparency of financial transactions in Indonesia, the following strategic steps are recommended:

1. Formulation of Clear Regulations that Support Innovation The government and regulators need to immediately formulate and issue clear regulations regarding the implementation of blockchain technology, including cryptocurrency and smart contracts. Clear and transparent regulations will provide legal certainty for fintech companies, encourage investment, and reduce legal uncertainty that can hinder the adoption of this technology.
2. Strengthening Technology Infrastructure To support maximum blockchain adoption, the government and private sector need to work

together to improve technology infrastructure, especially in areas that do not yet have adequate internet access and technology. The development of better digital infrastructure will accelerate the implementation of blockchain across the financial sector.

3. Improving Human Resource Literacy and Training Given the limited human resources trained in blockchain, it is important for financial institutions and fintech companies to improve the training and skills development of their employees in blockchain technology. In addition, educational institutions in Indonesia can play a role in providing more in-depth training programs to produce competent professionals in the blockchain field.
4. Collaboration between the Government and the Financial Sector Collaboration between the government, financial institutions, and fintech companies is essential to creating an ecosystem that supports the adoption of blockchain technology. By working together, all parties can formulate appropriate policies, identify existing challenges, and jointly seek solutions to encourage effective blockchain implementation in the financial sector.
5. Increasing Public Understanding of Blockchain In addition to providing training for professionals in the financial sector, it is also important to increase public understanding of blockchain technology and its benefits. This can be done through educational campaigns, seminars, and workshops to introduce the public to the basic concepts of blockchain and how this technology can improve a more transparent and secure financial system.

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