

Defining the Future: The Role of Blockchain Technology in Monitoring International Aid Funds

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Abstract

This article presents an in-depth analysis of blockchain technology's role in international aid fund management. The authors outline a conceptual framework illustrating how blockchain can be applied to improve aid monitoring systems, focusing on critical aspects such as transparency, recipient identification, and automation of fund distribution. We also discuss the ethical, security, and technology readiness challenges that may be faced in blockchain implementation. This article provides in-depth insight into how blockchain technology can address existing problems in international aid fund management by detailing concrete case studies and describing the research methods used. Research findings show that blockchain implementation has succeeded in increasing transparency, speeding up the distribution process, and optimising the use of aid funds. The article's result underscores the importance of continuing to pay attention to ethical, security, and inclusivity considerations while developing and implementing these technologies. By taking a holistic approach, using blockchain to monitor international aid funds can bring about significant positive change, increase efficiency, and support global development goals.

Keywords: *Blockchain, International Aid Fund, Transparency, Accountability, Digital Identity, Risk Management.*

A. INTRODUCTION

International aid plays a central role in the global context, forming the basis of humanity and solidarity between nations. In an increasingly connected and interdependent world, international assistance manifests concern between countries and is an essential strategy for overcoming shared global challenges (Hasan et al., 2021; Natarajan et al., 2017). Natural disasters, armed conflicts and other humanitarian crises know no national borders, and international aid provides a rapid and effective response to urgent needs as they arise; international aid is a powerful development instrument, supporting weaker countries to improve the welfare of their people; more details will be presented in the following paragraph:

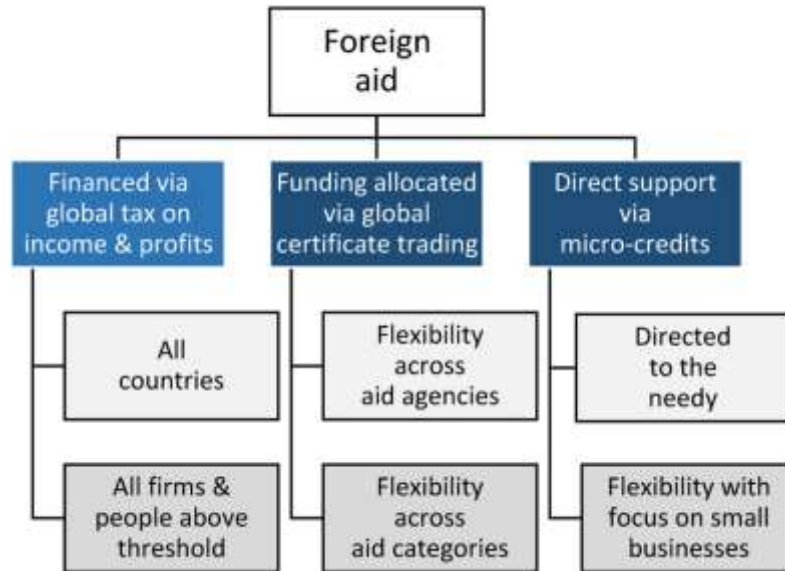


Figure 1. Financing short- and long-term aid

Source: Michael Hubler (2017)

Amid the current world turmoil, international aid is a reflection of global solidarity, showing that when one country experiences difficulties, other countries are willing to provide support. International aid is a philanthropic act and investment in world peace, security and stability, successful global development and addressing challenges require cross-border cooperation, with international assistance essential in shaping a more just and sustainable world (Aldag, 2019).

The importance of international aid can also be seen from a global moral and ethical perspective. When some countries have abundant resources while others experience poverty and deprivation, international assistance reflects a shared desire to address these disparities (Mohsin & Muneeza, 2019; Schmidt & Sandner, 2017). This involves a shared responsibility as global citizens to help those less fortunate, giving them access to education, health care, and other essential resources. International aid creates a global humanitarian network that shifts the focus from national to shared interests. International aid also has the potential to build positive relationships between countries, strengthen diplomatic cooperation, and create the foundation for world peace (Mukkamala et al., 2018; Reinsberg, 2021). In this way, of course, international aid is not only a response to crises but also a concrete step towards alleviating poverty, inequality and human suffering throughout the world, as an example of the following data:

Indonesia has benefitted the most from Netherlands' aid

Top 10 countries for Netherlands' international aid budget and total spending (1997-2018, €)

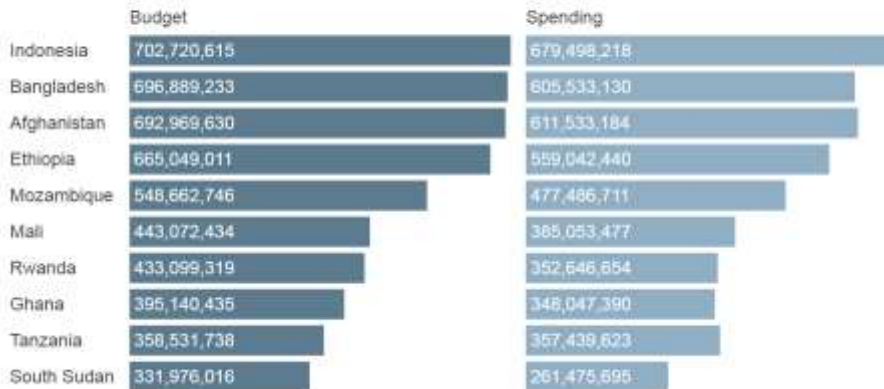


Figure 2. Data Stories: Where the Netherlands spends its aid money – and which former colonies it focuses on

Source: Your Data Stories

Due to the two countries' shared history and the colonisation of Indonesia by the Dutch, there is a close relationship between the two. The Dutch are trying to increase trade with Indonesia, now the fourth largest country in the world, and was once the Netherlands' largest colony. The Netherlands is financing many projects in Indonesia as part of this strategy, focusing on disaster-affected areas, such as Aceh and Nias, after the Christmas Day tsunami.

As the then Dutch Minister of Foreign Affairs, Frans Timmermans, put it in 2013: "Indonesia is a growing economic power in the region. We have historical ties, but our relations do not grow by themselves. We must invest more in people-to-people contacts, political, economic and cultural relations." There are other colonial legacies to be found in Dutch development spending. Although there is only a slight correlation between a country's population and aid spending allocated by the Netherlands between 1997 and 2018, some countries experienced high per capita spending levels.

With the world's interconnection continuing to increase, international aid is a tangible manifestation of the global spirit of working together to create a more just and sustainable world for all. Still, the challenges of managing and monitoring aid funds are increasingly complex, require better technology, and must be developed immediately (Hooper & Holtbrügge, 2020; Thomason et al., 2021).

The background to using blockchain technology in overcoming the increasingly complex challenges of managing and monitoring aid funds is realised by global conditions that continue to change and require a more innovative and efficient response. In recent years, the distribution of international aid funds has faced severe challenges, ranging from problems of non-transparency to the risk of losing funds due to corruption (Laroiya et al., 2020; K. A. Schulz et al., 2020). The increasing complexity of international

aid distribution chains and the need for high levels of accountability demand solutions that can provide security, transparency and sustainability.

Blockchain technology has become relevant due to its ability to create a decentralized, trusted and immutable system. By storing transaction data distributed across the network, this technology eliminates dependency on central authorities, reduces the risk of data manipulation, and creates a transparent trail that all relevant parties can access. In addition, blockchain ensures high data security and authentication, reducing the risk of fraud and unauthorised use of funds (L. T. Q. Nguyen et al., 2021; Q. K. Nguyen, 2016).

The relevance of using blockchain technology is also seen in efforts to increase operational efficiency. By utilising the concept of smart contracts, the process of distributing aid funds can be automated, speeding up responses to crises and minimising bureaucracy that slows down the distribution of aid. This technology's sustainability also allows tracking the use of funds in real time, allowing for more effective monitoring and making accountability easier to carry out.

In the face of increasing complexity and challenges in managing and monitoring international aid funds, blockchain technology is a promising solution. By integrating these principles, a more transparent, secure and efficient system can be created, which will increase the effectiveness of the distribution of aid funds and bring more significant benefits to those in need of humanitarian assistance (Al-Saqaf & Seidler, 2017; Till et al., 2017).

This research aims to investigate and document the role of blockchain technology in the context of international aid fund management and monitoring. With the growing complexity of aid distribution and increasing pressure to achieve high levels of transparency and accountability, this research aims to understand how blockchain technology can be an innovative tool in overcoming these challenges. Through an in-depth analysis of the implementation of blockchain in aid fund management, this research seeks to identify potential benefits, both in terms of operational efficiency and strengthening aspects of transparency, that can be obtained through the application of this technology. By focusing on these objectives, it is hoped that this research can provide in-depth insights valuable for decision-makers, practitioners, and researchers involved in international aid. More than just presenting technological solutions, this research also seeks to increase understanding of the positive impact that blockchain technology can have in increasing accountability and transparency in the distribution of global aid funds.

B. LITERATURE REVIEW

1. International Relief Fund

The International Relief Fund is the foundation for global efforts to address humanitarian crises, extreme poverty and inequality worldwide. As a natural form of solidarity between nations, these aid funds are channelled to help countries facing severe

challenges, ranging from natural disasters to armed conflicts. The aim is not only to provide emergency assistance but also to promote sustainable development, strengthen capacity, and improve the welfare of recipient communities. International aid funds can come from various sources, including donor governments, non-governmental organisations, UN agencies, and international financial institutions. The main challenges faced in managing and monitoring aid funds are non-transparency, risk of corruption, and lack of accountability. The role of blockchain technology in increasing transparency, security and efficiency in the distribution of international aid funds is becoming increasingly important. By combining the principles of decentralisation and distributed ledgers, this technology can provide innovative solutions to overcome the complexity of these challenges, bringing a significant positive impact in global efforts to improve the living conditions and welfare of people in need (de Villiers et al., 2021; Rehman et al., 2021; K. Schulz & Feist, 2021).

International aid funding has a deep humanitarian dimension, underscoring the need to respond quickly and effectively to urgent humanitarian crises, such as natural disasters, epidemics or armed conflict. In addition, aid funds are also a strategic instrument in promoting global peace and stability by supporting countries struggling to rebuild after conflict or facing severe economic pressure. Sustainable development is an essential focus of aid funds, with efforts to improve education, health and infrastructure in vulnerable communities (Andrii & Mariia, 2019; Shaheen et al., 2021).

The challenges faced in distributing aid funds show the need for innovation. Non-transparency and the risk of corruption can hinder aid funds' effectiveness, which is why the exploration of blockchain technology is becoming increasingly relevant. This technology opens up opportunities to create a fairer system, where every transaction can be clearly verified, and the sustainability of the use of funds can be monitored in real-time. Implementing blockchain technology is not only about increasing efficiency but also changing the paradigm in our approach to the distribution of international aid funds, creating a more open, fair and accountable environment (Dubey et al., 2020; McDaniel & Norberg, 2019; Sharma et al., 2020).

2. Blockchain Technology and the Concept of Decentralization and Distributed Ledger

Blockchain technology is based on revolutionary fundamental principles, changing how data and transactions are stored and verified across networks. The concept of decentralization, the main pillar in this technology, replaces the traditional model that relies on central authority. In a blockchain network, information is not stored or controlled by a single entity; instead, every participant in the network has a complete copy of the data. This creates a decentralised system where the entire community takes decisions jointly and transparently (Avdoshin & Pesotskaya, 2021; Demir et al., 2020).

Blockchain technology not only provides innovation in data storage but also brings a new paradigm in the way we view security, transparency and control over information. The basic principles of decentralization and ledger distribution in blockchain create a solid foundation for the establishment of a digital ecosystem that is fairer, more transparent and resistant to potential risks of manipulation or corruption, the working principle of blockchain is presented in the following image (Coppi & Fast, 2019; Trotter et al., 2020):

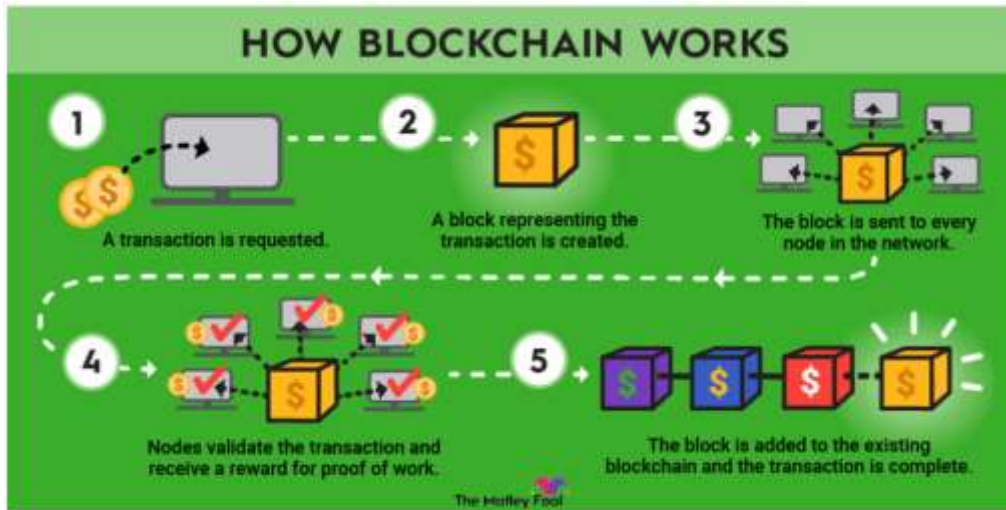


Figure 3. Blockchain Network
Source: (Thomason et al., 2018)

The concept of decentralization in blockchain also eliminates dependency on a central entity, reduces the risk of a single point of failure, and provides greater control to the individuals or organizations involved in the network. The existence of each node in the network has an equal role, allowing decisions to be taken democratically through network consensus. This creates an environment where trust can be built without the presence of intermediaries, such as banks or other financial institutions (Jahankhani et al., 2021; Rugeviciute & Mehrpouya, 2019).

The distributed ledger principle involves recording transactions in connected blocks, forming an immutable blockchain. Each block contains transaction information, and because each block is connected through cryptography, the integrity of the entire record remains guaranteed. This distributed ledger provides high security and resistance to data manipulation because to change one block, one must modify the entire chain of blocks distributed throughout the network (Reinsberg, 2019; Shin et al., 2020). This principle creates a transaction trail that can be easily verified and involves collective participation in the validation of each transaction, the explanation of which can be seen in the following image:

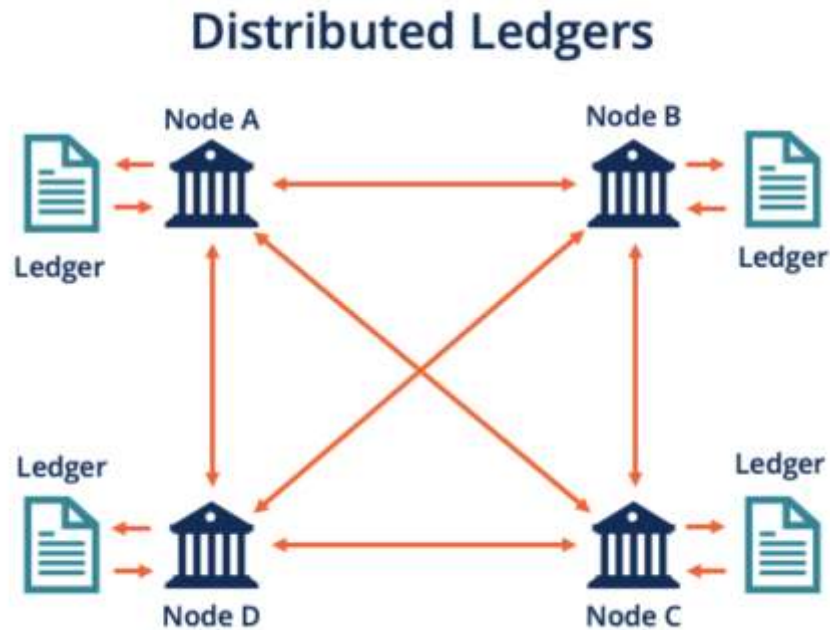


Figure 4. Distributed ledgers of Blockchain

Source: (Rugeviciute & Mehrpouya, 2019)

With this ledger distribution, every participant in the network has real-time access to recorded transaction history. This not only increases transparency but also provides resilience against unilateral data changes. The cryptography used to associate each block in the blockchain ensures that the information in the previous block cannot be changed without changing the entire chain, resulting in a very high level of security. Blockchain technology is a tool for storing data and a foundation for realizing a fairer, more efficient and trustworthy system. In the context of management and monitoring of international aid funds, the application of blockchain technology can bring about profound changes, ensuring that every dollar disbursed can be tracked transparently and providing confidence to all relevant parties that the funds are being used by the desired humanitarian objectives.

A deep understanding of the block structure and underlying cryptography is key to understanding how blockchain technology works. Block structure in the context of blockchain refers to how transaction data is grouped and organized in the smallest units called “blocks”. Each block has two main elements: header and body. The header contains meta information, such as the previous block hash, block creation timestamp, and nonce (a number used in mining), the body contains validated transaction data.

Cryptography plays a central role in blockchain security and integrity. The two main cryptographic concepts in blockchain are hash functions and digital signatures. Hash functions convert every block and transaction in the blockchain into a long, unique string called a hash. Each block contains the previous block's hash, creating linkage and

time order in the blockchain. If there is the slightest change to the block data, its hash will change completely, notifying the entire network of the change (Avdoshin & Pesotskaya, 2021; Thomason et al., 2018; Trotter et al., 2020).

Digital signatures are used for authentication and ensuring that transactions originate from legitimate parties. In blockchain transactions, private cryptographic keys are used to generate a unique digital signature. This signature can be verified by all parties using the appropriate public key. In this way, blockchain secures transactions and ensures that every entity participating in the network is legitimate. A deep understanding of blockchain's block structure and cryptography is crucial to explaining this technology's security, integrity, and transparency. With hash functions and digital signatures, blockchain creates a solid foundation for secure and decentralized data storage, addressing challenges in the monitoring and management of international aid funds (Andrii & Mariia, 2019; de Villiers et al., 2021; Rehman et al., 2021).

C. METHOD

This research applies a qualitative research approach. The research sample comprises various case studies on implementing blockchain technology in international aid fund management. Data collection methods include in-depth interviews with analysts and experts and analysis of related project documents. Data analysis was carried out through an inductive approach, focusing on empirical findings and patterns that emerged from implementing blockchain technology in the context of monitoring aid funds. The validity and reliability of the research were strengthened through data triangulation, while research ethics were maintained through obtaining ethical permission and data confidentiality. This method aims to provide a comprehensive understanding of the impact and potential of blockchain technology in increasing transparency and accountability in the distribution of international aid funds.

D. RESULT AND DISCUSSION

1. Advantages of Blockchain Technology in the Context of Monitoring Aid Funds

One concrete case study that has successfully applied blockchain technology in managing international aid funds is a project implemented by the International Development Assistance and Development Agency (USAID) in the Sub-Saharan Africa region. This project aims to increase the transparency and efficiency of the distribution of aid funds amidst challenges related to corruption and lack of access to the formal financial system. By utilizing blockchain technology in the long term, this project creates a decentralized platform that involves all stakeholders, including aid recipients, donor agencies and local partners. Every transaction, from fund allocation to its final use, is recorded in connected encrypted blocks, guaranteeing transparency and data immutability. The use of smart contracts allows automation of the distribution of funds

according to predetermined conditions, minimizing bureaucracy and ensuring that aid arrives on time.

Initial evaluation results show significant improvements in accountability and monitoring of funds, providing strong evidence that blockchain technology can bring positive changes in managing international aid funds. This case study clearly illustrates how blockchain technology can overcome the challenges faced in administering aid funds, paving the way towards a more transparent and efficient future in providing humanitarian aid. The results of interviews with informants are presented in the following paragraph:

The first question addressed to the analyst was as follows: *"How do you think the application of blockchain technology in the management of international aid funds can increase transparency and accountability?"*, the informant's answer was as follows:

"Generally, blockchain technology provides high security and transparency because every transaction is recorded in a distributed block that cannot be changed. This verifies the entire process by all stakeholders, increasing trust and accountability in using aid funds."

Analysts emphasize that blockchain technology can increase transparency and accountability in managing international aid funds. This ensures that every transaction can be easily verified by all relevant parties, paving the way to a more open and accountable distribution process.

The second question addressed to Blockchain Experts was as follows: *"What are the main challenges that may be faced in implementing blockchain technology in international aid fund management?"* the informant's answer was as follows:

"One of the main challenges is integration with existing systems and lack of digital literacy. A careful approach is required in ensuring that the entire ecosystem can adapt to this technology without hindrance."

Blockchain experts identify key challenges in implementing this technology, including integrating existing systems and varying levels of digital literacy. This challenge requires a careful approach to ensure the alignment of blockchain technology with the entire ecosystem.

The next question was aimed at the analyst regarding: *"What positive impacts can be seen from concrete case studies in certain countries that have successfully implemented blockchain technology in aid fund management?"* the informant's answer was as follows:

"Positive impacts include increased efficiency of fund distribution, reduced risk of misuse of funds, and the ability to provide more accurate and real-time reports."

Analysts highlight the positive impacts of concrete case studies, such as increasing the efficiency of fund distribution and reducing the risk of misuse of funds. This provides an understanding that the application of blockchain technology can bring real benefits in the context of international aid fund management.

The fourth question was addressed to Blockchain Expert informants, namely: *"How do you see Indonesia's level of readiness in adopting blockchain technology for international aid fund management?"*, the informant's answer was as follows:

"Indonesia has great potential with the growth of the startup ecosystem and increasingly better acceptance of technology. There is still a need to adjust infrastructure and increase digital literacy in several areas."

Blockchain experts see great potential in Indonesia with the growth of the startup ecosystem and increasing acceptance of the technology. However, there is a need for infrastructure adjustments and increased digital literacy, emphasizing that the journey towards blockchain technology adoption needs to be balanced with updates to the level of infrastructure readiness and human capacity.

The fifth question was addressed to analysts; the focus of the question was as follows: *"Are there certain technical aspects that need to be considered in adopting blockchain technology for international aid fund management?"* the informant's answer was as follows:

"It is important to pay attention to data standardization, interoperability between platforms, technological sustainability, and the need for involvement of all relevant parties in the implementation process."

Analysts highlight technical aspects such as data standardization, interoperability and technological sustainability as important factors. The involvement of all relevant parties is also highlighted as an important element in the implementation process.

The sixth question for Blockchain Experts was as follows: *"What areas do you think can benefit most from the adoption of blockchain technology in aid fund management in Indonesia?"*, the informant's answer was as follows:

"I see that the field of logistics distribution and tracking of aid funds, especially in handling natural disasters, can benefit greatly. This technology can ensure that help reaches the right location quickly."

Blockchain experts see the areas of logistics distribution and tracking of aid funds as the most beneficial in the Indonesian context. Blockchain technology can solve logistical challenges and ensure aid reaches the right location.

The final question for Analysts is as follows: *"How can the implementation of blockchain technology help overcome the specific challenges faced by Indonesia in the context of international aid fund management?"* The Analyst's answer was as follows:

"With a population distributed across multiple islands, blockchain technology can help create a transparent and secure footprint for every transaction, overcoming logistical challenges and ensuring that aid reaches every area in need."

Analysts note that blockchain technology can help overcome the specific challenges faced by Indonesia, especially in the context of a population distributed across various islands. By creating a transparent and secure footprint, this technology can help ensure aid reaches every area in need.

By summarizing the interview results, we know that blockchain technology has great potential to increase efficiency, transparency and accountability in managing international aid funds in Indonesia while overcoming existing challenges.

2. Security and Ethics in the Use of Blockchain Technology

Security is one of the main aspects that must receive serious attention in implementing blockchain technology. In this context, several key security aspects must be considered to ensure system integrity and resilience. First of all, the cryptographic aspects underlying blockchain become essential. Strong hash functions and trusted cryptographic algorithms are necessary to protect the integrity of the data in each block. Furthermore, special attention must be paid to the consensus mechanisms used in decentralised blockchain networks. Consensus methods, such as Proof of Work or Stake, must be chosen carefully to ensure the network is not vulnerable to 51% attacks or other manipulation.

Key management and user identity are also key in ensuring that access to the network and data remains secure. The use of digital signatures and careful access management are critical steps in protecting privacy and information security. The implementation and maintenance of smart contracts must also be closely monitored to avoid security gaps that unauthorized parties can exploit. By holistically considering all these security aspects, blockchain implementations can be carried out with a high level of trust, providing a safe and reliable solution in the context of international aid fund management or other fields.

To mitigate security risks in blockchain implementation, there are a number of current methods and practices that can be implemented. First, selecting secure and strong algorithms needs to be emphasized in the context of cryptography. Implementing hash functions such as SHA-256 or SHA-3 can improve block data integrity. The use of sophisticated encryption techniques at the data level is also necessary to protect the confidentiality of information stored in the blockchain, which can be seen in the following figure:

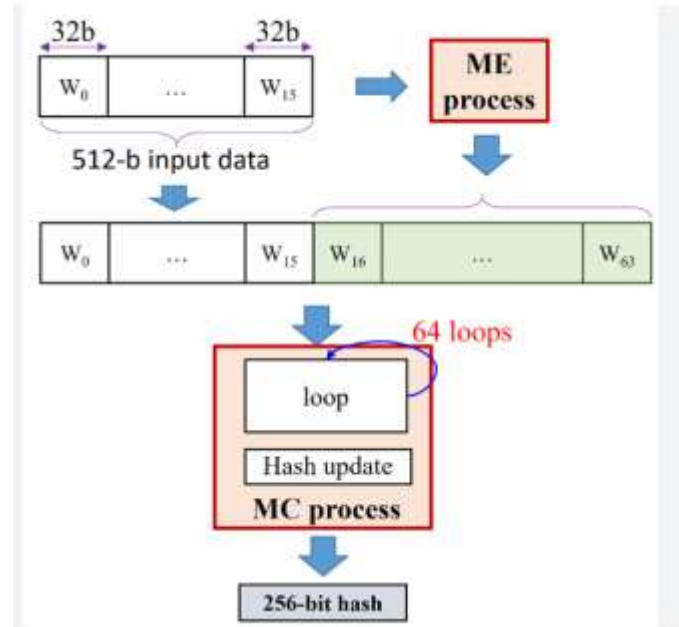


Figure 5. SHA-26 Overview

Source: (de Villiers et al., 2021)

The Proof of Stake (PoS) method has emerged as a more energy-efficient and secure alternative to Proof of Work (PoW) regarding consensus. PoS requires crypto-asset owners to place some or all of their coins as collateral, reducing the risk of a 51% attack. Key management is also a crucial aspect in mitigating security risks. Implementing strict key management policies, including using security hardware such as hardware security modules (HSMs), can protect private keys from unauthorized access. The practice of regular key rotation can reduce potential risks.

At the user identity level, even multi-factor authentication (MFA) systems are becoming effective for securing access. MFA requires users to provide more than one form of identification before accessing the blockchain network or data. Meanwhile, in the context of smart contracts, using secure programming languages and regular audits of smart contract codes can minimize security risks. Choosing a framework that has been proven to be secure and carrying out penetration testing can help identify potential security gaps.

Continuous security monitoring and analysis are essential. Using intrusion detection systems (IDS) and blockchain forensic analysis can help detect suspicious activity and respond rapidly to security incidents. By holistically implementing these methods and practices, organizations can mitigate the security risks associated with blockchain implementation, providing a strong foundation for system success and reliability.

The use of blockchain technology in monitoring international aid funds brings with it a number of ethical considerations that need to be carefully considered. The following are some relevant ethical considerations:

a. Data Privacy and Security

The use of blockchain technology brings challenges regarding data privacy and security. Even though information is generally encrypted and secure, total transparency can result in personal information leaks. Ethical Solutions to this problem Need to consider and design effective mechanisms to protect individual privacy and detail access levels appropriate to the roles and responsibilities of each stakeholder.

b. Empowerment or Stigmatism

Monitoring aid funds via blockchain can produce highly detailed transaction trails, which can stigmatise aid recipients if not managed carefully. Implementing policies that ensure that data collected and shared via blockchain does not create discrimination or stigma against aid recipients is important.

c. Community Participation and Involvement

Blockchain implementation can increase transparency, but citizens must also have control over their data. Community involvement in decision-making regarding this technology is an ethical imperative. Encourage participatory engagement and ensure that people understand how their data will be used and protected.

d. Crisis and Emergency Management

In emergency situations, the use of blockchain must consider the ethical impact regarding the speed of response and handling of the crisis. Technology delays or failures can have serious consequences. Deploying technology that can operate in emergencies and ensure that urgent needs come first can be an ethical solution.

e. Technology Accessibility

If blockchain technology is adopted, it is necessary to take into account its level of accessibility. If large portions of society do not have access to this technology, inequities may arise in monitoring aid funds. Efforts must be made to increase technology accessibility and ensure that implemented solutions do not leave communities less connected.

In dealing with these ethical considerations, it is certainly important to involve stakeholders proactively, ensure transparency in using blockchain technology, and prioritize humanitarian values and justice in monitoring international aid funds.

3. Future Challenges and Opportunities

The development of blockchain technology promises significant transformation in various industries, but along with its potential, there are also a number of obstacles and obstacles that need to be overcome. Some of them involve the following:

Table 1. Obstacles and Obstacles that need to be Overcome

Aspect	Constraint	Solution
Scalability	Blockchain currently faces obstacles in the scale of transactions that can be processed. As the network gets larger, the time required to verify and confirm transactions can increase.	Continuous efforts to improve scalability through developing new protocols and more efficient consensus, such as sharding or layer-2 solutions.
Difficulty Integration with Existing Systems	Blockchain integration with existing systems, especially legacy systems, can be complex and expensive	There is a need to develop standards and protocols that facilitate integration and sustainable migration strategies.
Regulatory Uncertainty	Regulation of blockchain and crypto assets still varies widely across countries, and this uncertainty can be a barrier to mass adoption.	Encouraging international cooperation and the development of clear regulations can help overcome uncertainty and increase trust.
Security	While renowned for its high security, blockchain also faces a growing risk of attacks. Attacks such as 51% attacks and backdoor attacks can threaten network security.	Implementing high security standards, regular penetration testing, and regular software updates are key to mitigating these risks.
Inability to Cope with Identity Issues	Although blockchain offers a high level of security, overcoming digital identity issues and the validity of information remains a challenge.	The development of decentralized digital identity solutions and stronger authentication protocols can help overcome these obstacles.
Inequality of Technology Access	Not everyone has adequate access or understanding of blockchain technology. This can create digital inequality and exclusion.	Broader education and training, as well as the development of friendlier user interfaces, can help

		overcome these accessibility barriers.
Environmental Impact	Some critics say that the Proof of Work (PoW) consensus method used by some blockchains, such as Bitcoin, has a large environmental impact because it requires high computing power.	Moving to more environmentally friendly consensus methods, such as Proof of Stake (PoS) or the development of more energy efficient solutions, is an ethical step to reduce environmental impact.
Crypto Value Instability	The fluctuating value of cryptocurrencies can be an obstacle to mass adoption and daily use.	Stablecoins, which are tied to fiat currencies or other assets, can help reduce volatility and increase acceptance as a means of payment.

Source: secondary data is processed

Overcoming these obstacles and constraints will require cross-sector collaboration, thoughtful regulatory development, and continued innovation in blockchain technology development. The future of blockchain technology offers a number of very interesting opportunities in the context of monitoring international aid funds. First, the transparency and accountability aspects brought by blockchain can provide a strong foundation for increasing trust between donors, aid recipients and other stakeholders. Every transaction and use of funds can be recorded transparently in a decentralized ledger, providing greater visibility into the flow of funds.

The potential to speed up the aid distribution and disbursement process is a big opportunity. Blockchain technology can facilitate the efficient handling of aid funds, especially in emergencies and emergency situations. Pre-programmable smart contracts can automate distributing of funds according to predetermined terms, reducing bureaucracy and response times. The development of decentralized digital identities is another opportunity that can help address the issue of access inequality and strengthen data security. With a secure and verified digital identity, monitoring of aid funds can be carried out more precisely and in a timely manner, providing a solution to the problem of verifying aid recipients.

Adopting blockchain technology can also stimulate cross-border cooperation between aid agencies, countries, and non-governmental organizations. The concept of a decentralized blockchain network provides a strong foundation for collaboration without the need for a third party to govern. This can create an ecosystem more integrated and responsive to urgent needs in various parts of the world. Opportunities also lie in

developing blockchain solutions focusing on sustainability and long-term positive impact. By using this technology, the implementation of aid funds can be more focused on advancing sustainable development, reducing inequality, and improving the standard of living of aid-recipient communities.

The development of blockchain technology in monitoring international aid funds can significantly contribute to global humanitarian and development efforts by exploiting this opportunity. Keeping ethical, security, and inclusivity considerations in mind, blockchain can redefine how we distribute, track, and monitor aid funds in the future.

E. CONCLUSION

Based on the results of data analysis and discussion results, it can be concluded that the development of blockchain technology offers great potential to improve the monitoring of international aid funds. The main advantage lies in increasing transparency, accountability and efficiency in the aid fund distribution process. Ethical, security, and technology readiness challenges must be addressed to ensure successful implementation. By taking ethical considerations into account, involving all stakeholders, and continuing to develop sustainable solutions, blockchain technology can shift the paradigm in managing international aid funds, significantly impacting humanity and global development.

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