



Blockchain Disaster Management for Humanitarian Logistic as Post-Disaster Response Measures

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ABSTRACTS

Indonesia has a high risk of earthquake and tsunami disasters because there's many tectonic plates meet. This also causes Indonesia to have many geological changes compared to other countries. Therefore, an explicit scheme to provide information related to disasters, like an information system in post-disaster management is important. The purpose of this research is to provide transparent information regarding the data on the goods needed and the data on goods to be distributed to ensure the amount used and not used, so that victims affected by disasters can be handled quickly and appropriately. The method used in this research is a literature review. The results of this study indicate the existence of a Blockchain Disaster Management Information System as a form of a new scheme in the post-disaster management process and is an upgraded form of information system that has been developed previously. This scheme uses the blockchain concept to provide transparency and data immutability. This scheme coordinates with various institutions such as BPBD (Regional Disaster Management Agency), BNPB (National Disaster Management Agency), BASARNAS (National Search and Rescue Agency), PMI (Indonesian Red Cross Society), the nearest hospital, and other related institutions.

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1. INTRODUCTION

Indonesia is highly threatened by earthquake and tsunami disasters (Kristian, R., 2018; Sudirman, *et al.*, 2020). The main reason why Indonesia has a high potential for catastrophe is that it is traversed by the Pacific Circumference or seismic belt, where many tectonic plates meet (Bariyah and Prastowo, 2020; Irawan, *et al.*, 2020). This also causes Indonesia to have many geological changes compared to other countries (Kristian, R., 2018). One of the threats of disasters that are very wary is the Lembang Fault. Based on research conducted by the Research Center for Geotechnology, Indonesian Institute of Sciences, the Lembang Fault stretches 30 km from the foot of Mount Manglayang to the Padalarang area in West Bandung Regency (Pamungkas and Ningrum, 2022). In addition, many studies have been conducted to determine the impact caused by an earthquake on the Lembang Fault (Widodo, *et al.*, 2017). Therefore, in the face of this great threat, a scheme is needed to help people potentially affected by the disaster. One of them is a post-disaster assistance scheme.

Providing assistance to victims affected by disasters is intended to ease the survival of victims, improve the economy, and open information or access to sources and opportunities for social security so that the survival of victims can be assisted (Fatkhullah, *et al.*, 2022). However, the problem is that the provision of social assistance often creates new problems. An example of this problem is the accumulation of donations, as happened at the Penanggal Village Hall, Candipuro District (Mulyono and Paramith, 2022). Used clothing donations piled up to three meters high, and many were wasted because the amount exceeded the community's needs. Similar to what happened in Cianjur at the end of 2022, there was a buildup of clothing aid due to the large amount of support sent to that point (Aslam, *et al.*, 2021).

Furthermore, irresponsible persons or parties often use social assistance. The lack of attention from the public and government to this matter is an opportunity for irresponsible individuals to carry out their actions (Leliana, *et al.*, 2021; Launa and Lusianawati, 2021). This misuse will be very detrimental to many people, not just the people affected by the disaster. Therefore, knowing about this and how to handle it (Tantimin, *et al.*, 2021) is necessary. Based on these problems, it is necessary to provide accurate, precise, and reliable information regarding the data on the goods required, the goods to be distributed, and the transparency of aid, which is then neatly arranged and well integrated.

Table 1. Previous Technology Comparison

TITLE	DISADVANTAGES
Mahdia, F. and Noviyanto, F. 2013. Utilization of Google Maps API for the Development of Logistics Mobile Web-Based Post-Natural Disaster Yogyakarta City Regional Disaster Information Assistance Management System (Case Study: Management Agency). Jurnal Sarjana Teknik Informatika, 1(1), pp. 162-171.	The information system created is mobile web- based. Disadvantages, the scheme does not apply the principles of transparency and immutability so that admin or officer is able to modify the data that has been entered from the user.

TITLE	DISADVANTAGES
Imaniawan. F. F. D., 2020. System Web-based Donation Distribution Information System Web-based Donation Information System. IJSE Indonesian Journal on Software Engineering,6(1), pp. 44-45.	Web-based donation distribution information system. The drawback of the scheme is that it does not display data on what needs are needed. Thus, problems to be avoided such as unused donations at the location can occur and this scheme also lacks the principles of transparency and immutability.

2. METHODS

The research method used was a Literature Review with the scope of study from journals over the last ten years. Literature sources are taken from various journal providers websites, such as ScienceDirect and Google Scholar. The implementation method of making the "Blockchain Disaster Management for Humanitarian Logistics as Post-Disaster Response Measures" system is carried out in stages. The implementation we used in this activity is shown in the flowchart in **Figure 1**.

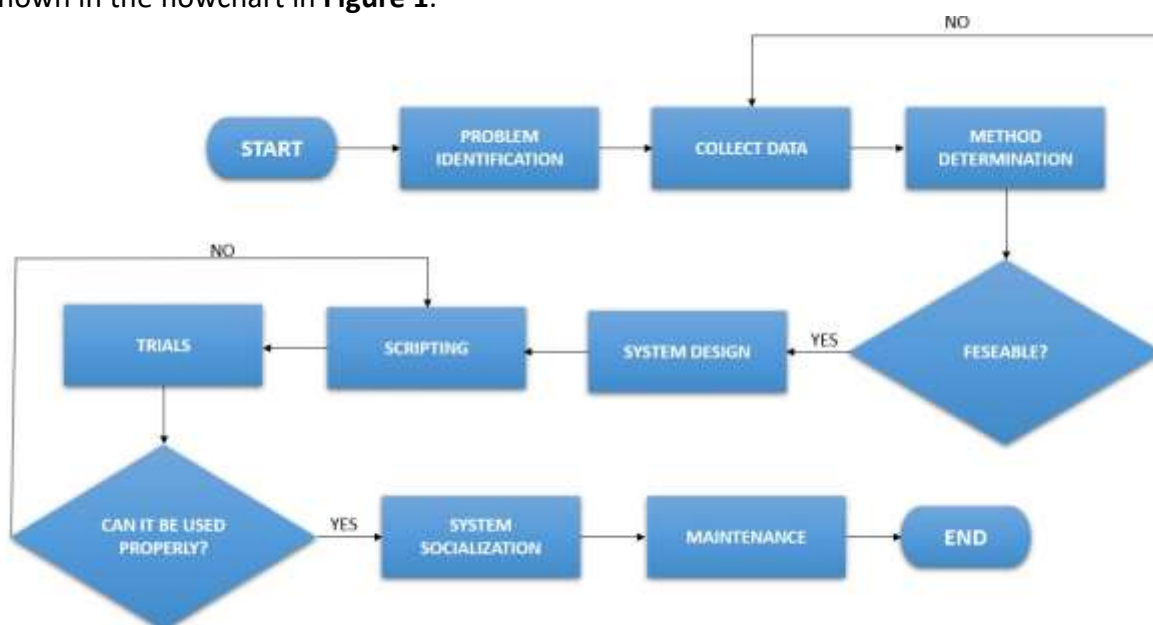


Figure 1. Flowchart

After identifying the problem, the next step is to collect data relevant to post-disaster management, especially in Indonesia, the technology utilized in the disaster management process in Indonesia, and the application of blockchain technology in information systems. The current stage of this research is on system design. The conceptualization of the design system that will be implemented. There are three system designs used. First, a special place for documents online is divided into two: those that can be seen by the public (open data) and special stakeholder access (closed data). Then, the next system design is reusable design and development components.

3. RESULTS AND DISCUSSION

Information systems are software that can help organize or analyze data. The primary purpose of information systems is to convert raw data into helpful information for an agency or organization. The processing results concern decision-making in the organization (<https://www.ekrut.com/media/sistem-informasi-adalah>). One of the technologies that can be developed in information systems is Blockchain Technology (Ghosh, 2019).

A blockchain is a set of blocks that are connected and form a chain (Fanning and Centers, 2016). Blockchain technology combines several technologies, such as cryptography, peer-to-peer (P2P) networks, smart contracts, and consensus mechanisms, to create a unique and new database (Wu and Tran, 2018). In addition, blockchain technology records details, such as the date, time, participants, and other laws or contracts of each transaction (Santhi and Muthuswamy, 2022).

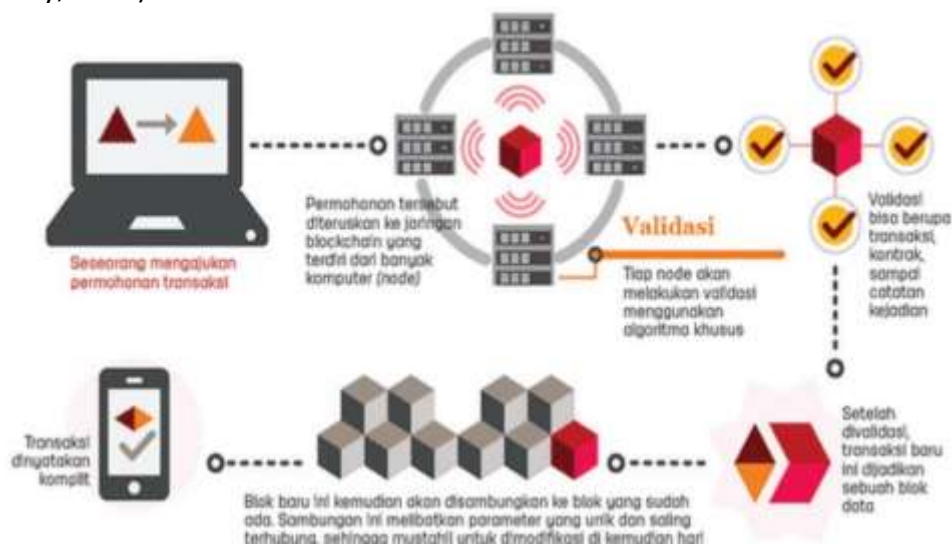


Figure 2. Blockchain Technology Workflow (source:

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwi9m9rNoPSAAxXc3TgGHTrNDEgQFnoECBsQAQ&url=https%3A%2F%2Fwww3.weforum.org%2Fdocs%2FWEF_Building-Blockchains.pdf&usq=AOvVaw3xbEHywW7CSTib89k32GuH&opi=89978449)

Blockchain technology is considered capable of forming a new era in information systems or what is commonly called information system 3.0 (Aoun, *et al.*, 2021). The 3.0 information system is a further evolution of the internet by implementing a peer-to-peer and decentralized system. One of the reasons blockchain technology can form a new era for the internet is because it can transmit value without a center of profit and service providers monopolizing data (Patrickson, 2021). There are many concrete examples of blockchain today, for instance, in blogging platforms such as Steemit or even charity platforms such as Bitgive.

The application of information systems in Indonesia has been widely used, especially for disaster management institutions such as BASARNAS (National Search and Rescue Agency) and PMI (Indonesian Red Cross Society). However, there are still shortcomings. The BARATA (West Java Cultures Disaster Resilience) Information System menu in the disaster reporting information system on the bpb.d.jabarprov.go.id web does not have a transaction feature between donors and recipients of donations or information on the details of logistics needs. Donors and recipients of donations and information on the details of logistical needs that

need to be explained in detail on the site, as shown in Figure 3 below. Just like the BARATA Information System owned by BPDB (Regional Disaster Management Agency) West Java, the information system of BNPB's (National Disaster Management Agency) Indonesian Disaster Data Geoport, as shown in Figure 4, related to logistics needs data is still not recorded in real time, which can cause problems, such as real time so that it can cause problems, such as the accumulation of donations.



Figure 3. Display of BARATA Post-Disaster Management Information System

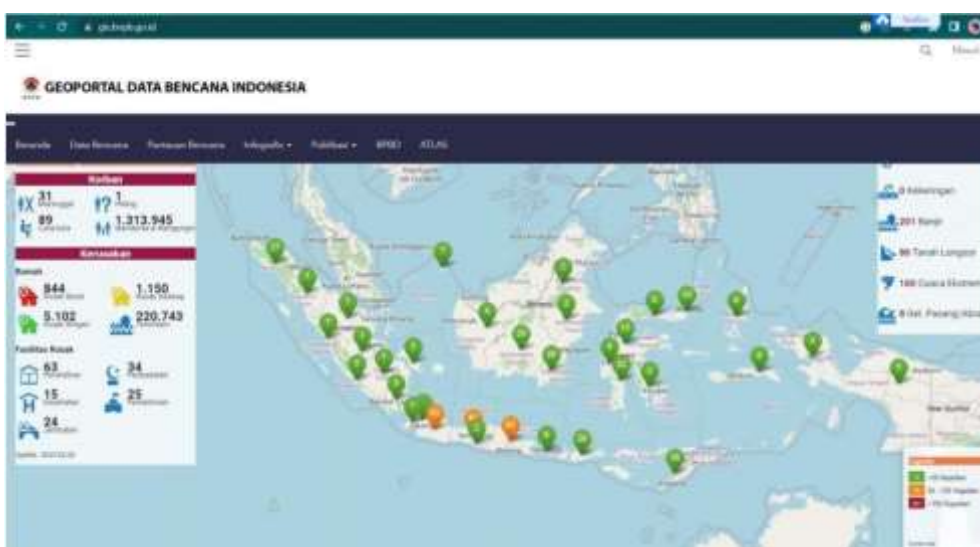


Figure 4. Display of Indonesia Disaster Data Geoport Information System

On the PMI post-disaster management website as shown in **Figure 5**, the data provided is not real time but rather the result of a recapitulation. Therefore, the data provided need to be updated with the actual conditions. Then, the website also does not have the exact number of logistics needs in the field and also does not apply blockchain technology which causes the data provided to lack transparency and is not immutable. The donation feature on the PMI website there is two types, namely donations to PMI and donations directly to the local government account or through the BPBD call center of the affected area. There needs to be further information for data donations to PMI, such as the number of donations that have been collected and their distribution. Donation data that goes directly to local governments or BPBDs in disaster-affected areas only state the nominal amount of donations received from stakeholders and do not display the allocation of funds to related parties. This is also related to the need for more transparency in the information system on the PMI website.



Figure 5. PMI Post-Disaster Management Information System View

3.1. Blockchain Disaster Management

The result of this study is a website-based information system called Blockchain Disaster Management. This information system uses the blockchain concept in collecting and displaying information. All information is real time data. The information displayed includes the location affected by the disaster with three indicators (mild, moderate, severe), the number of victims (injured, dead, missing, displaced) integrated with data from BNPB, the amount of infrastructure damage, logistical needs, and features for donations.

The Blockchain Disaster Management information system uses blockchain technology to accurately distribute aid to disaster-affected areas. This system is integrated with population administration and civil registry data, the Ministry of Home Affairs, and institutions that play a role in disaster management, such as BNPB, BPBD, BASARNAS, PMI, and the nearest hospital. This system can provide the number of victims in a disaster-affected area so that related institutions that are integrated into the system can directly distribute aid with an initial estimate, and the aid data that has been allocated will be directly displayed in the system. If there is a shortage of the amount of assistance that has been distributed, it will be immediately known so that it can be prepared immediately. All data listed is data in real time. The Blockchain Disaster Management information system is accessible to the general public. The benefit of this information system is that it can improve the process of disaster management, transparency in the process of distributing aid, and the accuracy of the amount and target. In addition, the presence of this system can make it easier for donors and volunteers to find out the type and amount of assistance needed in areas affected by disasters in real time. If this is developed or improved by a web developer, it can be implemented in the broader region, and its function can be improved.

The Blockchain Disaster Management (BDM) information system will have a D-Day core page as shown in Figure 6. The D-Day page will display information when a disaster occurs and in real time by utilizing blockchain technology.

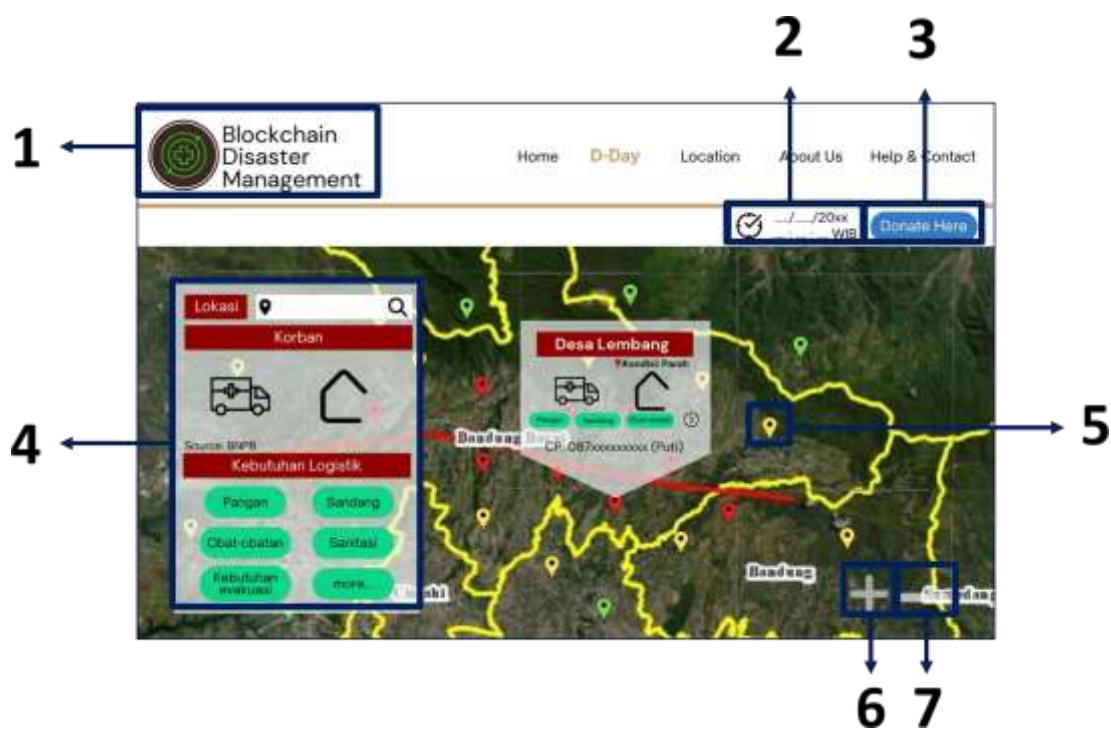





Figure 6. D-Day Main Menu Display

Table 2. Description

No	System Elements Information	Description
1	Logo and Name	Showing identity
2	Real Time	Indicates that the information is displayed in real time
3	Data Collection Features Help	Data collection of aid information for victims affected
4	Victim Data Feature, Damage Infrastructure, and Logistics Needs	<ul style="list-style-type: none"> - Locations affected by the disaster - The ambulance logo will display data on affected victims (dead, missing, injured, suffering, and displaced). Integrated with data from BNPB - The house logo will display damaged infrastructure (houses, education, health, worship, and public facilities) - Various logistical needs required by disaster victims, such as clothing, food, medicine, sanitation, evacuation needs, etc.
5	Village Points Affected Fault Earthquake Disaster Lembang	<p>Areas around or affected by the earthquake on the Lembang Fault are classified into three categories:</p> <ul style="list-style-type: none">  Severely Affected Village  Moderately Affected Village  Lightly Affected Village
6	Zoom In	Enlarge Map of Affected Villages
7	Zoom Out	Shrinking the Map of Affected Village

Determining the category of damage that occurs is done by direct coordination through BPBD (National Disaster Management Agency), with the flow as shown in **Figure 7**.

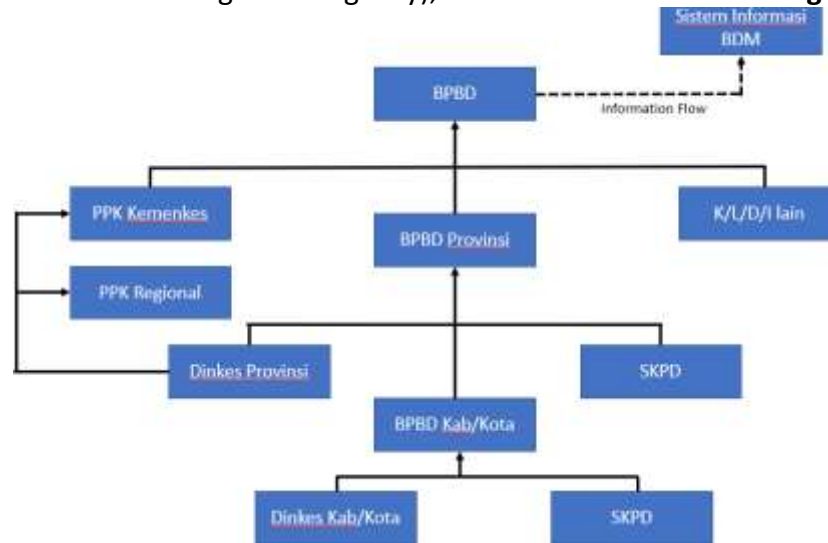


Figure 7. Information Flow of Disaster Damage Impact Category

On the D-Day page, both website visitors and potential donors can find out various Information includes,

- (i) the affected areas or villages with three indicators (severe, moderate, mild),
- (ii) the number of victims, and
- (iii) the logistical needs.

The information displayed is comprehensive—information as a whole. If you want information about victims in a particular location, you can type or search for the name of the area you want to know in the “Lokasi” section. In the “Kebutuhan Logistik” section, there are several needs, such as food, clothing, medicine, sanitation, evacuation needs, and more (other needs). If the need is clicked, it will display the information about the need with more details.

Figure 8 is an example of detailed information displayed after clicking the “Pangan” sub menu in the “Kebutuhan Logistik” section. The information displayed is in the form of the type of food needed and its quantity, such as rice needed 1kg, corn needed 1kg, sugar needed 1kg, instant noodles needed 1 box, milk needed 1 box, and drinking water needed 1 box. If you want to search for food needs in a more specific area, you can type the name of the area in the “Lokasi” section.



Figure 8. Food Sub Menu Display on D-Day Menu

Furthermore, there is a feature for donations, "Donate Here". This feature is for collecting information related to donors and assistance provided to victims of the victims affected by the earthquake on the Lembang Fault so that the amount of aid that has been received and the number of needs that are still needed.

After clicking the "Donate Here" feature, a page will appear as shown in **Figure 9**. On the Informasi Bantuan page, there are several projects, such as the construction of aid posts and the rebuilding of damaged infrastructure. Donors can also assist with these projects by filling in the required information, such as the donor's full name, home address, destination village, type of assistance to be provided and its quantity, and delivery method. Then, in this feature, the flow of the aid is shown in **Figure 2**, where the transaction will be visible and approved by all partners on this website using a blockchain smart contract with the flow shown in **Figure 10**. Every successful transaction will become a new block in the blockchain, which we then display on the website as "Our Donator" for transparency of the transactions made.



Figure 9. Donate Here Sub Menu Display on D-Day Menu

On the "Informasi Bantuan" page are several projects, such as the construction of aid posts and the rebuilding of damaged infrastructure. Donors can also assist with these projects. On the project page on the project page, there is information on the assistance and information

on the donors briefly. Then, in this feature, the flow of the aid is shown in **Figure 2**, where the transaction will be visible and approved by all partners on this website. Will be able to be seen and approved by all partners on this website using a blockchain smart contract with the flow is shown in **Figure 10**.

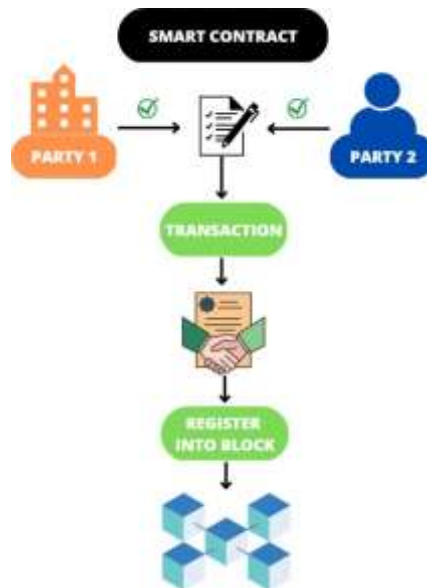


Figure 10. Smart Contract Concept

Figure 11 is the view after clicking one of the projects on the “Informasi Bantuan” page (**Figure 9**). On this page, the assistance provided by donors means that it is intended for the project. Donors must fill in the required information. Then, same as before, every successful transaction will become a new block in the blockchain, which we then display on the website as "Our Donator" for transparency of the transactions made



Figure 11. Sub Activity View of Donate Here Sub Menu

4. CONCLUSION

The great threat of disasters in Indonesia is necessary for all parties involved in developing schemes in mitigation to disaster management. One scheme that needs to be considered is the flow of information regarding post-disaster assistance to help victims quickly and precisely. The intended information system scheme already exists and has been developed. However, some shortcomings must be finalized again. The existing weaknesses are related to transparency, data immutability, and the exact number of needs related to the needed assistance. In overcoming these problems, the Blockchain Disaster Management (BDM) Information System uses the blockchain concept to provide transparency and data immutability so that it will reduce the cunning in giving financial assistance carried out by irresponsible people or institutions. This scheme coordinates with various institutions such as BNPB (National Disaster Management Agency), BPBD (Regional Disaster Management Agency), BASARNAS (National Search and Rescue Agency), PMI (Indonesian Red Cross Society), and the nearest hospital in providing information related to the impact of damage, the number of victims, and the logistical needs needed.

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