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Blockchain Technology For Circular Economy in Plastic Bank

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Abstract: With the use of blockchain technology, this research sought to understand the applications, benefits, and limitations faced by circular economy-based businesses. This research was conducted at the Plastic Bank Company, which used a digital conference room to allow interviews that could not be conducted in person, as well as the researcher's residence for online data gathering and document review. Five management members of the Plastic Bank Company comprise the sample population. The information used is first-hand information derived from interview findings. In order to acquire data, several methods including interviews, document analysis, and observation were applied and tested by Triangulation. The findings of this study revealed: 1) Companies with a circular economy may employ blockchain technology to change supply chain operations, tracking, and tracing. 2) Blockchain technology has benefits for businesses based on the circular economy, including easier distribution management, less duplicate papers, increased cost effectiveness, and the ability to turn plastic trash into digital cash. 3) The general public is still unaware of the use of blockchain technology for businesses that rely on the circular economy. Furthermore, the company's success is constrained on a small scale due to the absence of finance from affiliated parties. Therefore, in order to grow the use of technology on a big scale, this circular-based economy firm for plastic banks has to strengthen its performance and efforts.

Keywords: Blockchain, Circular Economy, Plastic Bank Company, Digital Cash, Supply Chain

INTRODUCTION

Unknowingly, environmental issues have a profound and troubling effect on people's lives all around the world (Javanmardi et al., 2023). A hard and complex situation exists in the modern world without a doubt as a result of substantial growth in human communities. Large-scale energy production, economic expansion, longer life expectancies, and better literacy rates have all been observed throughout the last several centuries. However, these successes have created numerous challenges for sustainability (Shaukat et al., 2022). The environment is also significantly influenced by our political, economic, and social activities (Khuc et al., 2023). Even purchasing and selling activities have an effect on the environment, as do almost all human actions. Plastic wrapping for their items is frequently employed in purchasing and selling operations. However, if the trash from plastic packaging is not correctly managed in the end, plastic may become an extraordinarily negative thing. When it comes to waste management, Indonesia is one of the standouts (Irianto et al., 2022).

Indonesia is rated 151st in the world according to a report by the non-profit group Earth.org based on the 2020 Global Sustainability Index (Mulhern, 2020). This is a very concerning record, thus Indonesia has to change it right now. The existence of circular economy-based businesses can be a helpful catalyst for attempts to establish a sustainable economy that is environmentally conscious. One of them is a business similar to Plastic Bank (Bhubalan et al., 2022). Plastic Bank is a social enterprise that was first established in Vancouver, Canada May 2013 committed to solving ocean plastic waste and global poverty (Katz & Frankson, 2020). Plastic Bank encourages residents in developing areas to collect plastic waste, transporting it to a local processing centre, and using a specially designed mobile application as a trading platform to exchange digital tokens (Katz, 2020). Additionally, the Ministry of

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Environment's research reveals that homes account for the majority of the waste composition. The information below is shown in Figure 1.

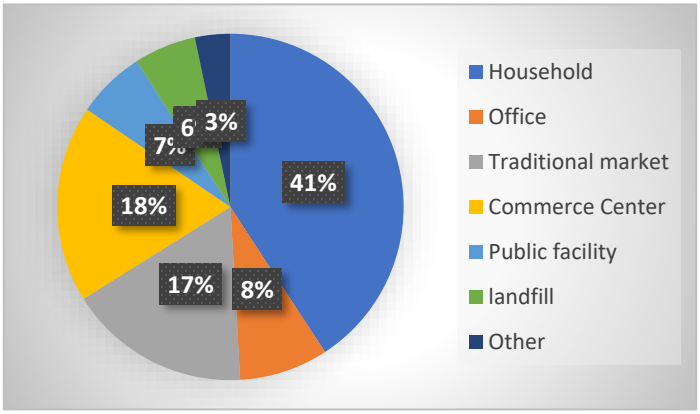

Figure 1. Indonesian Waste Composition Based on Waste Sources

According to Figure 1, households account for 40.8% of Indonesia's garbage sources. The term "garbage" or "household waste" refers to waste generated by normal home activities and excludes excrement and other special waste. Other people's health will be impacted by the effects of home trash on the environment, such as lowered air quality. Regarding the Management of Household Waste and Household-Like Waste, Household Regulation No. 81 of 2012 Managing domestic trash or rubbish results in less concern for the home environment as a whole, fewer landfills, and more aggressive enforcement of the law against offenders. Recycling, burning, preparation, composting, and decomposition are just a few of the waste management techniques that may be applied. A trash management and pollution reduction strategy is plastic banks.

Companies based on the circular economy have already implemented blockchain technology, including Plastic Finance in Indonesia and Plastic Bank in Canada (Hatzivasilis et al., 2021). The term "circular economy" refers to a way of thinking about how the economy functions and operates effectively at many sizes, including those of governments, individuals, and businesses operating locally and globally (Weetman, 2020). The circular economy is the most recent remedy for the issue of plastic waste at the moment (Khadke et al., 2021). The Ellen MacArthur Foundation, a non-profit organization formed as a worldwide thought leader that puts the circular economy on the agendas of decision-makers in industry, government, and education, is the organization that pioneered the circular economy. In 2010, the Ellen MacArthur Foundation was established with the goal of accelerating the shift to a circular economy (Kouhizadeh et al., 2020). The "circular economy" is described as a framework for systems solutions that address major issues including climate change, biodiversity loss, waste, and pollution on the EMF website (Kofos et al., 2022). Simply said that had been found by several studies before, the circular economy makes efficient use of plastic trash to help minimize plastic waste (Kumar et al., 2021; Zhao et al., 2022).

Systemic improvements associated with the circular economy result in long-term resilience, open up new business and economic opportunities, and improve society and the environment (Suchek et al., 2021). Businesses are rapidly adopting the circular economy concept, whether as a CSR initiative or even as a whole business model (mainly new corporations); this adoption trend is the result of company initiatives, non-profit organizations, or government fund-raising campaigns (Chen et al., 2020). Many of the circular economy-based businesses that have arisen also reflect this adoption trend (Bianchini et al., 2019). Therefore, customers' perceptions and information management are only two of the numerous challenges that businesses or organizations will encounter while adopting the circular economy in business processes (Awan & Sroufe, 2022). Because of this, a fresh strategy is required to get over these challenges, and one such strategy is Blockchain technology (Chidepatil et al., 2020).

There are circular economy-based businesses that have used blockchain technology to assist their business processes (Klaveren et al., 2022). Blockchain technology has the ability to boost Circular Economy performance and become a good complement to one another (Upadhyay et al., 2021). The prior study found that blockchain technology and smart contracts can facilitate the automation of transaction processes in a permanent and verifiable manner, saving time and resources and eliminating inefficiencies or waste (Böckel et al., 2021). For example, smart contracts can help

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prevent product degradation in advance by sending real-time alerts for inspection as soon as IoT sensors in a container indicate that required environmental conditions are being violated (Chang et al., 2020). Therefore, accurate records in product production and delivery are advantages of employing blockchain technology. According to the statement above, the authors are reportedly interested in researching "Implementation of Blockchain Technology for a Circular Economy in Plastic Banks."

LITERATURE REVIEW

Reducing greenhouse gas emissions and advancing the UN's Sustainable Development Goals (SDGs) program are primary goals of the circular economy (Weetman, 2020). The circular economy has fast gained popularity across the globe. The circular economy is supported widely by the majority of the world's largest companies, the World Economic Forum, and most NGOs. It is promoted by the United Nations and the European Union (EU), serves as the cornerstone of environmental policies for many governments, and has been adopted as a framework for policy by hundreds of cities. engaging in environmental work (Chen et al., 2020). The Ellen MacArthur Foundation (EMF), an organization created exclusively to promote and facilitate the march towards a circular economy, is another global institution dedicated to the circular economy (Kouhizadeh et al., 2020). Besides, the Circular Economy is described as a system-solution framework on the EMF website that handles issues like climate change, biodiversity loss, waste, and pollution (Klaveren et al., 2022). This description offers a clear understanding of the Circular Economy as a means of addressing environmental issues.

Blockchain is described as a decentralized ledger that simultaneously keeps transaction data on numerous computers. Some cryptocurrencies use blockchain technology to record transactions. Blockchain technology serves as the foundation for the bitcoin network (Kouhizadeh et al., 2020). Experts in the circular economy have long been intrigued by blockchain due of its potential for material tracing. But it requires more teamwork to achieve the enormous system-level benefits it provides. Therefore, blockchain technology has the potential to improve Circular Economy performance and work well in conjunction with it. (Upadhyay et al., 2021). Simply said, the circular economy effectively utilizes plastic waste to reduce plastic waste, as proven by multiple previous studies (Kumar et al., 2021; Zhao et al., 2022). According to the previous study, blockchain technology and smart contracts can enable the permanent and verifiable automation of transaction processes, saving time and resources while reducing inefficiencies or waste. Smart contracts, for example, can help prevent product degradation by delivering real-time notifications for inspection whenever IoT sensors in a container indicate that required environmental parameters are being broken (Chang, Iakovou, & Shi, 2020 ; Böckel, Nuzum, & Weissbrod, 2021).

METHOD

This study employs a qualitative methodology with the kind of primary data obtained through the interview with descriptive analysis. Frist data collected from Primary data, such as those gathered through interviews with Plastic Bank management, were used in this study since they were directly from the research object and were acquired and analysed for the first time by researchers. Three different methods of gathering data were used: interviews, observations, and documentation (Sugiyono, 2018). Triangulation techniques, such as source triangulation, technical triangulation, time triangulation, and theory triangulation will be used to assess the findings of the data acquired for validity. Data reduction, data presentation, and conclusion-drawing are the three stages of research data analysis.

RESULT

Respondent Characteristics

Informants who knew and were directly associated with management at plastic bank firms participated in interviews. Five informants were used in this study, three of them were men and two of whom were women. The average age of the informants is over 25 years old. The informants also have an undergraduate or bachelor's degree in economics based on their educational backgrounds. This source was gathered by obtaining samples from businesses that handle plastic banks in a circular economy. Given that the informant is more knowledgeable about the use of blockchain technology, which is closely tied to businesses based on the circular economy, this is taken into account.

Results of Interviews and Observations

The interviewers replied with many questions on how plastic banks may be used to apply blockchain technology for a circular economy. The three major questions are broken down into three categories: the implementation of blockchain technology, the advantages and disadvantages for companies using the circular economy, and the

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consequences for the circular economy. Each primary question item is briefly examined before being categorized and further discussed according to category. The table that follows displays the categorical findings of the interviews.

Table 1.
The result of interview

No.	Statements	Recapitulation of Answers	Interviewers [I]
1	The Implementation of Blockchain Technology for Circular Economy-Based Companies [S.1]	Blockchain technology can help supply chains for companies based on circular economy, especially plastic.	I1, I 2, I 4, I 5
		Blockchain technology can trace or track every logistics distribution movement in circular economy-based companies, especially plastic.	I1, I2, I3
		Blockchain technology has driven progress for plastic waste recycling efforts. The results of recycling plastic waste are stored in plastic banks and get tokens.	I1, I2, I3, I4, I5
2.	Advantages of Implementing Blockchain Technology by Circular Economy-Based Companies [S.2]	Blockchain systems can manage warehouse networks and can cut costs incurred in managing inventory and storage.	I1, I2, I3, I4, I5
		The blockchain system can record every movement for, transfer all intermediary media and simplify document flow by ensuring data security and auditability.	
		The blockchain system can help product recycling into value-added products and by obtaining these tokens can be exchanged for money.	
3.	Obstacles Faced by Circular Economy-Based Companies in Implementing Blockchain Technology [S.3]	The adoption of blockchain technology is still not accessible to the wider community due to a lack of understanding of this technology.	I1, I2, I3, I4, I5
		Low supply of funds or funding from companies and the government.	
		The operation of blockchain technology in circular economy enterprises is still on a small scale.	

Source: Primarily data have been proceeded, 2022

Data sources for the research on the use of blockchain technology for a circular economy on plastic banks could be assessed based on the findings of the interviews in Table 1. The data validity method used in this study employs triangulation methods. In order to increase the level of confidence (credibility/validation), data consistency, and usefulness as a tool for data analysis in the field, triangulation is a strategy for validating data (Sugiyono, 2018). Source triangulation, technical triangulation, temporal triangulation, and theory are all examples of triangulation techniques.

Results of Interviews and Observations Based on Source Triangulation

Source triangulation is the process of double-checking the information collected from informants by confirming the accuracy of information or data from one informant to another. The five (5) primary informants from Plastic Bank Management were used in this study.

The summary of the response in the first statement, which was based on source triangulation, revealed that blockchain technology may assist supply chains for businesses based on the circular economy, particularly in the plastic industry. The interviewers for I1, I2, I4, and I5 have responded to this claim. Additionally, the interviewees in I1, I2, and I3 stated that enterprises based on the circular economy may use blockchain technology to trace or track every logistical distribution movement, particularly plastic. More specifically, all of the interviewees concurred that advancements in the recycling of plastic trash had been facilitated by blockchain technology. You receive tokens for recycling plastic garbage, which is then placed in plastic banks. There is a certain pattern that shows how blockchain technology is used, as shown by all of the explanations in the responses above, chiefly:

a) Can aid the supply chain.
b) Able to trace or follow each logistical distribution move.

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c) The use of blockchain technology has accelerated attempts to recycle the plastic debris that has been kept in plastic banks while earning tokens.

The respondents' responses were summarized, and it was discovered that every interviewer concurred with the second assertion shown in table 1 as well. The benefits of using blockchain technology by businesses based on the circular economy may be summarized as follows:

a) Can handle a network of warehouses.
b) Reduce the costs associated with managing and storing inventories.
c) Capture each movement the vehicle makes.
d) Transfer all intermediary media, streamlining the document flow while maintaining data security and auditability.
e) Recycle waste into useful items that can be used to earn tokens that can be sold for cash.

Furthermore, the recapitulation of the respondents' response revealed that all of the interviewers agreed with the third statements that has been illustrated in the table 1. There is a clear pattern that shows obstacles faced by circular economy-based companies in implementing blockchain technology. The following are the challenges encountered:

a) The general public still cannot adopt blockchain technology.
b) A lack of funding.
c) Blockchain technology is still being used on a modest basis in circular economy businesses.

Results of Interviews and Observations Based on Technical Triangulation

Technical triangulation involves comparing data from the same source using several approaches in order to assess the veracity of the information. Data collected during an interview, for instance, may be verified by observation as follows:

1. First statement. According to researches, circular economy-based businesses, particularly plastic banks, have successfully used blockchain technology. The usage of this technology also allows for the connection of several parties to a single network. Each participant in one such network exchanges data with the others. Transparency, which may prevent data tampering, is a given with data sharing. As a consequence, businesses employ this technology extensively to make sure that the supply chain, tracking every distribution move, and recycling of plastic garbage all go as planned.
2. Second statement. Researchers have found that the blockchain technology system used by businesses has aided the world's commerce in plastics, a challenging area of this economy. The business has also been successful in managing the system to provide transparency on cost concerns, which can reduce expenses associated with inventory management and storage. Similar information is available for the recording and transmission of all intermediate media devices. The flow of papers that ensure data security and are auditable can also be made simpler. The benefits of blockchain technology are then used to recycle plastic garbage, and the provider offers tokens that can be converted into cash.
3. Third statement. Researchers have noted that one challenge is that the general public is not familiar with blockchain technology. As a consequence, society adopted this technology at a lower cost. The cost of distribution amongst businesses is another factor that is undoubtedly fairly significant. Due to the limited income of cash, both from the government and other communities, there is not an appropriate distribution of plastic trash and recycling among enterprises. Additionally, this circular economy business uses blockchain technology on a modest scale.

Results of Interviews and Observations Based on Time Triangulation

The passage of time has a big impact on how reliable the statistics are. Data gathered through interviewing procedures in the early morning, while the informants are still awake and unhampered, will yield more reliable data. In this study, interviews and observations began at 9:00 in the morning and continued till they were completed. Since they were done at busy times and the justifications were still new, the results of the interviews and observations in this study may be regarded valid data.

Results of Interviews and Observations Based on Theory Triangulation

Theory triangulation is founded on the supposition that facts may be tested for their level of belief with competing explanations rather than one or more theories (Sugiyono, 2018). Therefore, the results of previous interviews and observation studies will be linked to the theoretical basis of this study and previous research.

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According to (Macarthur, 2017) and a statement from the European Parliament in 2021, a circular economy is a framework for systemic solutions, such as a production and consumption model, that solves major problems including pollution, waste, and climate change. As a result, it necessitates procedures that entail renting, sharing, reusing, repairing, upgrading, and recycling goods. In this approach, the product life cycle is extended in order to address important issues like pollution, waste, and climate change through models of production and consumption. This makes processes like renting, sharing, reusing, mending, upgrading, and recycling necessary. The product life cycle is prolonged in this way. It is important to pay attention to plastic waste since it is one of the sources of pollution and environmental harm. Blockchain technology, in particular, can speed up the monitoring and distribution processes needed to determine which companies are in charge of handling the challenging plastic waste distribution.

According to (Kouhizadeh et al., 2020) blockchain is a decentralized ledger that keeps track of transactions on several computers at once. The shared ledger has query capabilities for quick processing and encodes the whole transaction history for each channel. The blockchain's application logic is included in the application layer (Saberi et al., 2019). It provides a readable interface where users can track their transactions. Transactions at this layer can be represented as token exchanges between two participants where each transaction goes through a validation process before being deemed valid.

Given these two primary theoretical investigations, it is possible to infer that the utilization of blockchain technology to enterprises that streamline supply chains and the recycling of plastic waste into valuable goods has been demonstrated in accordance with the circular economy theory explanation. The process of applying blockchain technology in this business has also demonstrated a number of benefits for its consumers in line with the blockchain theory, including the advantage of being able to trace every step and swap plastic trash for tokens that can subsequently be redeemed.

This is in accordance with previous research found that the efficiency of plastic recycling can be improved enormously by using the blockchain technology. Automation for the segregation and collection of plastic waste can effectively establish a globally recognizable tool using blockchain-based applications (Khadke et al., 2021). Using blockchain technology, segregators, recyclers, and manufacturers can reliably share data, plan the supply chain, execute purchase orders, and hence, finally increase the use of recycled plastic feedstock (Chidepatil et al., 2020). This shows that technology can support the market in supply chain management practices for a product that is the same as this plastic waste.

DISCUSSIONS

The Implementation of Blockchain Technology for Circular Economy-Based Companies

Following the findings of interviews with informants, who have been grouped into the categories in Table 1, the majority of the informants said that companies with a circular economy can advance recycling programs by using blockchain technology to create plastic waste that will be stored in plastic banks and given tokens. Sources offered responses indicating that the use of blockchain technology may benefit the supply chain and can detect or track every logistical distribution move in circular economy-based businesses, particularly plastic.

Observations reveal that businesses, particularly in the domain of bank plastic, have successfully used this Blockchain technology based on the circular economy. Additionally, using this technology makes it possible to connect several parties into a single network. Each user in one of these networks exchanges data with the others to converse. Transparency and the possibility to end data tampering are two additional benefits of data sharing. In order to ensure that the supply chain is efficient, that every distribution movement is documented, and that plastic trash is recycled, businesses effectively employ this technology.

The plastic bank application is one of the initiatives the corporation has put in place to recycle plastic trash. Blockchain technology is utilized in this application to track suppliers and recycling procedures. This is reinforced by the development of additional apps, such as a company called "Plastic Finance" that was founded by young people in the country and promotes the circular economy by recycling plastic garbage. Following the collecting of plastic garbage, blockchain technology—in this case, cryptocurrency tokens—is incorporated (Admin, 2022). Therefore, here are some graphical user interface (GUI) displays in the plastic bank application used by a user in Indonesia.

The recycling businesses nearest to us, together with their costs and inventory, are shown in figure 2 below. In addition, we may build our own recycling center, as seen in the right image. A green conversation box with the words "redemption history" is located beneath it. The token sale transaction takes place there. The accompanying figure 3 illustrates how to track the recycling shop's location on the display, view pricing, and make a purchase using tokens.

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The closest partners to the area are depicted in the graphic on the left. After clicking on one of the stores, the specifics of that shop are displayed in the centre image, as seen in the picture. The right-hand image then displays information about the store and the cost of bank cards that may be used to buy tokens. For instance, the pricing for Plastic - PET - Clean - Mix is 4,700 IDR/kg. So, if we can gather 1 kilogram of plastic garbage, we may use tokens to swap it for Rp. 4,700.00. Figures 4 and 5 in the following sub-chapter will provide more clarification of the processes of token-based transactions between customers and retailers.

The results of the study also showed the same results as research by Peshkam (Peshkam, 2019). According to him, there are three important points about Blockchain Opportunities. The first is that every plastic product can be tracked through a digital watermark. Second, consumers can generate crypto credits or some kind of token for recycling. Third, digital supply chains can trace plastics from products that are no longer used (waste) into something that can still be reused. Thus, the product does not die or lose its quality but is given an opportunity through an innovative design philosophy of a second life for product generations in the future.

In addition, blockchain has an important role in the circular economy by implementing circulation. Circulase is developing an open-source blockchain-based communications protocol to promote value chain transparency without public disclosure about data sets or supply chain partners. Circularise also uses smart contracts and zero-knowledge tokens (verification tools that prove value without disclosing any further information). Its blockchain architecture serves to facilitate data collection, and other exchange of value points between participants while allowing them to remain anonymous (Upadhyay et al., 2021).

Advantages of Implementing Blockchain Technology by Circular Economy-Based Companies

Each informant provided opinions about the benefits of blockchain technology for businesses with a circular economy based on the findings of interviews with informants who have been grouped according to Table 1. A benefit of employing blockchain technology, according to all sources, is the ability to manage warehouse networks and save expenses. Additionally, this blockchain-based system can keep track of each truck movement and transfer of intermediate media. By guaranteeing high data security and auditability, the benefits of this blockchain can also assist in streamlining document flow. Blockchain can support recycling into items with more economic value in addition to aiding with administration or data.

This is consistent with the claim that a circular economy may minimize waste while processing the leftover goods that can still be used to enable future economic value creation (Koscina et al., 2021). Therefore, the degree of environmental concern through recycling plastic trash will be increased with the aid of blockchain technology in order to decrease plastic waste. This is in line with a claim that while evaluating blockchain technology, it's critical to consider audibility, anonymity, persistence, decentralization, and trust (Kouhizadeh et al., 2020).

The observations also demonstrate that, although being a complex sector of the economy, the global plastics trade is governed by the same basic principles that apply to all other economic activity: supply and demand. The enormous quantity of plastic that ends up in our seas each year can be recycled, but if we want to recycle more, the market for recycled plastic needs to grow. Unfortunately, corporations today have little to no incentive to purchase recovered plastic and put it to alternative uses. Technology and advocacy both play a role in this. Clarifying the locations of plastic production, usage, and disposal requires a worldwide infrastructure. This level of traceability will help determine which companies are polluting the most, which will give recycled plastic products a place in the market (L. W. Admin, 2022). This can be seen from an example of a plastic waste tracking system in terms of sales using tokens in the blockchain system as shown below:

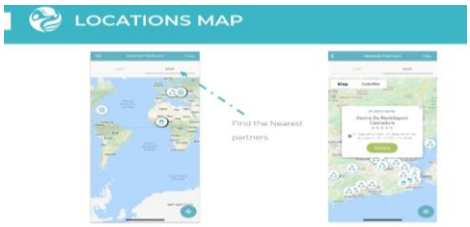

Figure 2. Location Map to Find the Nearest Partner Used Blockchain
Source: Plastic Bank Application, 2022

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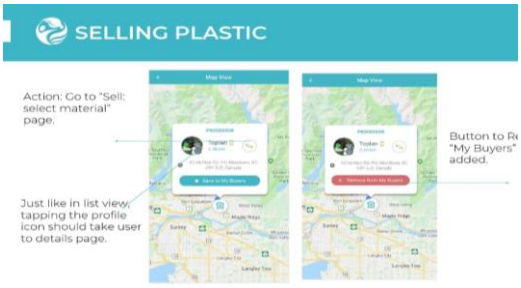

Figure 3. Location Map to Find the Nearest Partner Used Blockchain
Source: Plastic Bank Application, 2022

It is clear from Figures 2 and 3 that selling tokens on the blockchain and tracking plastic waste are not difficult processes. To perform the token transaction, we first need to locate a buyer or partner who is close to us on the location map. After locating a number of partners or customers, we may select one of them by clicking the blue dialog box to include the customer as our sales partner. The "Sell: choose material page" may then be used to complete any sales or purchases.

In addition, the ease of accessing accurate data makes it easier for this circular economy-based company to plan optimal inventory levels, which will have an impact on inventory and warehousing cost efficiency. With the existence of the blockchain, the growth of Plastic Bank's business has pushed plastic into money, where blockchain turns plastic into digital currency, as well as having social value. This system can have an impact that changes people's lifestyles.

Obstacles Faced by Circular Economy-Based Companies in Implementing Blockchain Technology

According to the findings of interviews with informants who have been grouped according to Table 1 each informant provided their opinions on the barriers that circular economy-oriented businesses are putting in the way of blockchain technology. According to all available information, the main barrier to the widespread adoption of blockchain technology is that this technology is still not well-known and understood by the general public. Additionally, there is still a lack of money available from the government and business sectors. As a result, the use of blockchain technology in circular economy businesses is relatively limited.

This blockchain technology is brand-new and is still not commonly used by the general public. In addition, neither the government nor organizations associated with the circular economy have the funds to use this technology in plastic banks. As a result, circular economy businesses can only operate on a small scale using plastic banks. As a result, there are a number of approaches that may be used to get over these challenges;

a) Holding seminars or workshops in various regions to convey knowledge about the benefits of blockchain in reducing plastic waste, especially in areas that contribute the most plastic waste.
b) Companies are able to provide levels of welfare such as BPJS, scholarships, or subsidized facilities (computers or mobile phones) for the less fortunate, especially those who work to collect plastic waste (such as scavengers).
c) Hold promotions regarding the importance of blockchain technology that is easy to access and use every day and get more government support to increase funding so that it can operate on a larger scale.

On the other hand, using blockchain technologies for supply chains presents considerable obstacles, particularly with regard to the safeguarding of sensitive data and unwillingness to share data with others. For many businesses, keeping anonymity is essential to sustaining their competitive edge. One of the main challenges for blockchain development for circular economy (CE) is overcoming obstacles in physical-digital connectivity. As a result, one of the recommendations the authors might make based on these results is to make the blockchain system more secure.

CONCLUSION

According to the study's conclusions, businesses using a circular economy may use blockchain technology to alter supply chain tracking and operations. Additionally, firms based on the circular economy may profit from blockchain technology by managing distribution more easily, producing fewer duplicate documents, saving money, and turning plastic waste into digital currency. The application of blockchain technology for companies that rely on the circular economy is yet unknown to the general public, it was also discovered in the study. Additionally, the lack

of funding from related parties limits the company's viability on a small scale. Therefore, this circular economy business for plastic banks has to improve its performance and efforts in order to increase the use of technology on a large scale

REFERENCES

Admin, L. W. (2022). *Lonely Whale: tracking plastic waste thanks to blockchain*. Lobelywhale.Org.

Awan, U., & Sroufe, R. (2022). Sustainability in the Circular Economy: Insights and Dynamics of Designing Circular Business Models. *Applied Sciences (Switzerland)*, *12*(3). https://doi.org/10.3390/app12031521

Bhubalan, K., Tamothran, A. M., Kee, S. H., Foong, S. Y., Lam, S. S., Ganeson, K., Vigneswari, S., Amirul, A.-A., & Ramakrishna, S. (2022). Leveraging blockchain concepts as watermarkers of plastics for sustainable waste management in progressing circular economy. *Environmental Research_Elsevier*, *213*(5), 58–80. https://doi.org/10.1016/j.envres.2022.113631.

Bianchini, A., Rossi, J., & Pellegrini, M. (2019). Overcoming the main barriers to the implementation of the circular economy through a visualization tool for circular business models in Ecuador. *Sustainability (Switzerland)*, *11*(23).

Böckel, A., Nuzum, A. K., & Weissbrod, I. (2021). Blockchain for the Circular Economy: Analysis of the Research-Practice Gap. *Sustainable Production and Consumption*, *25*, 525–539. https://doi.org/10.1016/j.spc.2020.12.006

Chang, Y., Iakovou, E., & Shi, W. (2020). Blockchain in global supply chains and cross border trade: a critical synthesis of the state-of-the-art, challenges and opportunities. *International Journal of Production Research*, *58*(7), 2082–2099. https://doi.org/10.1080/00207543.2019.1651946

Chen, L. H., Hung, P., & Ma, H. wen. (2020). Integrating circular business models and development tools in the circular economy transition process: A firm-level framework. *Business Strategy and the Environment*, *29*(5), 1887–1898. https://doi.org/10.1002/bse.2477

Chidepatil, A., Bindra, P., Kulkarni, D., Qazi, M., Kshirsagar, M., & Sankaran, K. (2020). From trash to cash: How blockchain and multi-sensor-driven artificial intelligence can transform circular economy of plastic waste? *Administrative Sciences*, *10*(2), 125–147. https://doi.org/10.3390/admsci10020023

Hatzivasilis, G., Ioannidis, S., Fysarakis, K., Spanoudakis, G., & Papadakis, N. (2021). The green blockchains of circular economy. *Electronics (Switzerland)*, *10*(16), 173–195. https://doi.org/10.3390/electronics10162008

Irianto, O., Mizuno, K., Burhanuddin, S., & Triaswati, N. (2022). Formulating an Excise Duty on Plastic: A Strategy to Manage Marine Plastic Waste in Indonesia. *Sustainability (Switzerland)*, *14*(23), 1–16. https://doi.org/10.3390/su142316287

Javanmardi, E., Liu, S., & Xie, N. (2023). *Exploring the Challenges to Sustainable Development from the Perspective of Grey Systems Theory*.

Katz, D. (2020). *Plastic Bank: Recycling ecosystems*. IBM [Online]. https://www.ibm.com/blogs/corporate-social-responsibility/2020/04/plastic-bank-recycling-ecosystems/

Katz, D., & Frankson, S. (2020). *Plastic Bank*. Plastic Bank. https://plasticbank.com/about/.

Khadke, S., Gupta, P., Rachakunta, S., Mahata, C., Dawn, S., Sharma, M., Verma, D., Pradhan, A., Krishna, A. M. S., Ramakrishna, S., Chakrabortty, S., Saianand, G., Sonar, P., Biring, S., Dash, J. K., & Dalapati, G. K. (2021). Efficient plastic recycling and remolding circular economy using the technology of trust–blockchain. *Sustainability (Switzerland)*, *13*(16). https://doi.org/10.3390/su13169142

Khuc, Q. Van, Tran, M., Nguyen, T., Thinh, N. A., Dang, T., Tuyen, D. T., Pham, P., & Dat, L. Q. (2023). Improving Energy Literacy to Facilitate Energy Transition and Nurture Environmental Culture in Vietnam. *Urban Science*, *7*(1), 13. https://doi.org/10.3390/urbansci7010013

Klaveren, R. van, Zwitte, A., & Huiskes, T. (2022). Towards A Circular Economy : Integrating Blockchain Technology Into Supply. *BSc Global Responsibility and Leadership*, *1*(1), 1–31. https://doi.org/https://campus-fryslan.studenttheses.ub.rug.nl/160/

Kofos, A., Ubacht, J., Rukanova, B., Korevaar, G., Kouwenhoven, N., & Tan, Y. H. (2022). Circular economy visibility evaluation framework. *Journal of Responsible Technology*, *10*(6), 158–179. https://doi.org/10.1016/j.jrt.2022.100026

Koscina, M., Lombard-Platet, M., & Ribalta, C. N. (2021). A blockchain-based marketplace platform for circular economy. *Proceedings of the ACM Symposium on Applied Computing*, *1*(6), 1746–1749. https://doi.org/10.1145/3412841.3442136

Kouhizadeh, M., Zhu, Q., & Sarkis, J. (2020). Blockchain and the circular economy: potential tensions and critical reflections from practice. *Production Planning and Control*, *31*(11), 950–966. https://doi.org/10.1080/09537287.2019.1695925

Kumar, R., Verma, A., Shome, A., Sinha, R., Sinha, S., Jha, P. K., Kumar, R., Kumar, P., Shubham, Das, S., Sharma, P., & Prasad, P. V. V. (2021). Impacts of plastic pollution on ecosystem services, sustainable development goals, and need to focus on circular economy and policy interventions. *Sustainability (Switzerland)*, *13*(17), 1–40. https://doi.org/10.3390/su13179963

Macarthur, E. (2017). Towards the Circular Economy Vol. 2: Opportunities for the Consumer Goods Sector. *Ellen MacArthur Foundation [Online Version]*, *1*(1), 1–10.

Mulhern, O. (2020). *Indonesia – Ranked 151st in the Global Sustainability Index*. Earth.Org.

Peshkam, M. (2019). *TRANSFORMING PLASTIC POLLUTION Toward a World Without Single-Use Plastic*. *August*.

Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). *Blockchain technology and its relationships to sustainable supply chain management*. *7543*. https://doi.org/10.1080/00207543.2018.1533261

Shaukat, M. B., Latif, K. F., Sajjad, A., & Eweje, G. (2022). Revisiting the relationship between sustainable project management and project success: The moderating role of stakeholder engagement and team building. *Sustainable Development*, *30*(1), 58–75. https://doi.org/10.1002/sd.2228

Suchek, N., Fernandes, C. I., Kraus, S., Filser, M., & Sjögrén, H. (2021). Innovation and the circular economy: A systematic literature review. *Business Strategy and the Environment*, *30*(8), 3686–3702. https://doi.org/10.1002/bse.2834

Sugiyono. (2018). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. ALFABETA.

Upadhyay, A., Mukhuty, S., Kumar, V., & Kazancoglu, Y. (2021). Blockchain technology and the circular economy: Implications for sustainability and social responsibility. *Journal of Cleaner Production*, *293*, 126130. https://doi.org/10.1016/j.jclepro.2021.126130

Weetman, C. (2020). *A Circular Economy Handbook: How to Build a More Resilient, Competitive and Sustainable Business*. Kogan Page Publishers.

Zhao, X., Korey, M., Li, K., Copenhaver, K., Tekinalp, H., Celik, S., Kalaitzidou, K., Ruan, R., Ragauskas, A. J., & Ozcan, S. (2022). Plastic waste upcycling toward a circular economy. *Chemical Engineering Journal*, *428*(June 2021), 131928. https://doi.org/10.1016/j.cej.2021.131928