Reducing Fraud, Waste, and Abuse in International Aid Supply Chains using Blockchain

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Introduction

Supply chains are an integral part of manufacturing, disaster management, charity, as well as many other sectors. Currently, supply chains are susceptible to many potential inefficiencies. For example, supply chains are prone to be affected by fraud, waste and abuse. Hence, this project seeks to explain how the implementation of smart contracts and block coupled with Internet of Things (IoT) to solve the inefficiencies currently existing within the supply chain, using development aid as an example.

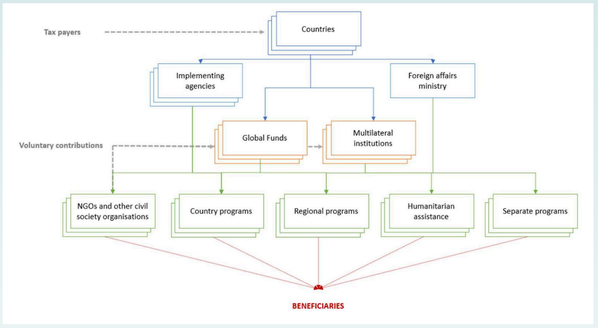

Figure 1: The complex flow of development aid[1].

The Problem

The humanitarian action and development aid sector can be examples where inefficiencies and bad faith actors inhibit the efficacy of various initiatives. Figure 1 highlights the numerous potential agent in the development aid sector. Given the fact that there are often many agencies dealing with large sums of money, the lack of transparency can result in many agents not knowing what is happening with partnering agents. The development aid model can be compared to a Black Box model as it is hard to look where money is going. In some cases, you cannot look at all. As a result, funds can often end up duplicated, or on the other hand, some projects may be underfinanced. Supply chain flaws can be exploited at different stages in the development aid process. For example, fund leakages can be as a result of corrupt officials, confusion among agencies or the complexity of transactions. Even if the full aid amount makes it through these stages, there is no guarantee that the local recipient Governments have a sufficient oversight, and consequently struggle with allocating and prioritizing funds[1]. Traditionally, the only efforts to combat these downfalls have been the implementation of various legislative policies that require greater reporting requirements of acting agents (e.g., the 2014 Assessing Progress in Haiti Act)[2]. Though these policies are beneficial, they do not eliminate inefficiencies that may arise due to there being humans in the loop. For example, reports often have omissions and deficiencies in data, or can be difficult to identify where mistakes are.

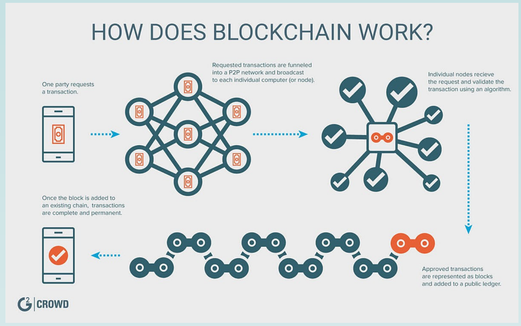

Figure 2: Visualizing how blockchain works.

Technology

A blockchain refers to an immutable public ledger that stores transaction data. Blockchains are comprised of a collection of nodes that are connected over a Peer-to-Peer (P2P) network. Thus, consensus is needed among all nodes for a block to be added to the network. As a result, blockchains secure transaction by the decentralization of authority[2]. Figure 2 shows how blockchain works in more detail. That is, the formation of a block starts when an agent requests a transaction. This request is then sent through a P2P network and broadcasted to individual computers. Individual transactions are continuously made and fed into the network where they are combined into one block. When a block is filled, miners race to solve the proof of work by competing to complete a complex cryptographic problem. Doing so generally requires access to large-scale energy resources and computing power. Whoever solves the cryptographic problem receives newly minted coins as well as a portion of transaction fees. The block is also then securely added to the immutable public ledger (blockchain), thus preventing future tampering. Once the block is added, the transaction is complete and permanent. Figure 3 shows the benefits associated with the implementation of blockchain.

Additionally, a smart contract is "a computerized transaction protocol that executes the terms of a contract"[3]. Additionally, they are lines of code stored on the blockchain that are executed when predetermined terms are met. Smart contracts and Blockchain are especially beneficial when it comes to dealing with data-driven transactions. Lastly, Internet of Things (IoT) refers to computing devices that and send and receive data.

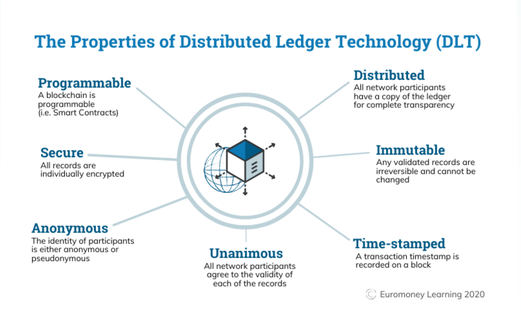

Figure 3: The Benefits of Blockchain technology.

Case Study

Most of the leakages are most likely to occur at the 2nd and 3rd tier shown in Figure 1. Data sharing between different agencies over a blockchain would help increase the transparency and efficiency of information. The 2010 earthquake in Haiti prevents a good example of the failures that can arise from the development aid supply chain. Haiti caught the attention of the global stage when the 7.0 magnitude earthquake struck its capital, leading to the displacement of 1.6 million people, the death of over 300,000 people and the destruction of infrastructure thus severely affecting the country's economy[5]. The earthquake resulted in approximately $14 billion dollars in damage. Consequently, the restoration of Haiti became the focus of many charities and development aid agencies. By the end of 2010, the US Government, through USAID, initially allocated almost $720 billion dollars in aid to be sent to Haiti for relief efforts[6]. Almost a decade later, it is estimated that USAID has spent over $2 billion dollars. Although most of the aid efforts were intended to help the Haitian people and their economy, the Center for Economic Research and Policy reports that only approximately 2% of funds went Haitian organizations. As seen in Figure 3, most of the aid went back to US organizations.

Application

The implementation of blockchain, smart contracts, and IoT in this case of Haiti would have allowed for a more effective allocation of funds. Access to a public ledger of transactions stored on a blockchain. In terms of Figure 1, that would mean that all transfers of money from tier to tier would be recorded on a public blockchain.

The benefits of implementing blockchain technology can be shown by using a bag of flour from the factory in Canada to its final destination in Haiti. Blockchain, smart contracts and IoT sensors can be implemented at every stage of the supply chain. That is, from factory , to truck, to warehouse, to departing dock, to ship, to receiving dock, to truck, distribution warehouse, to local aid agency, then finally to the end recipient. At the factory, the IoT sensors are placed on the bag of rice. Sensors allow the package to be tracked throughout its journey by GPS. For example, once the sensors determine that the package has safely arrived at the warehouse from the factory, and that the required payments have been made with no issues, a smart contract is then automatically executed confirming the completion of the transaction. This stage is then stored in a block and added to the public blockchain for all participants to see. The logistic-related information is tracked at all steps throughout the bag's journey. If the sensors pick up any suspicious activity, such as the flour disappearing, or damage to the packaging etc., then the courier receives a financial loss in reduced payment or even the cancellation of the contract. Because all steps of the transaction are stored on the public ledger are visible to all participating agents and are immutable (cannot be altered after verification and inclusion into the blockchain), the likelihood of fraudulent transactions or leakages is less likely to occur. As a result, more money and goods can effectively make it to those in need.

Meshing of the physical world and the virtual world, in terms of IoT devices and blockchain, could have prevented many of the leakages that are believed to have happened. At worst, this technology would have allowed governing organization to track where the funds went.

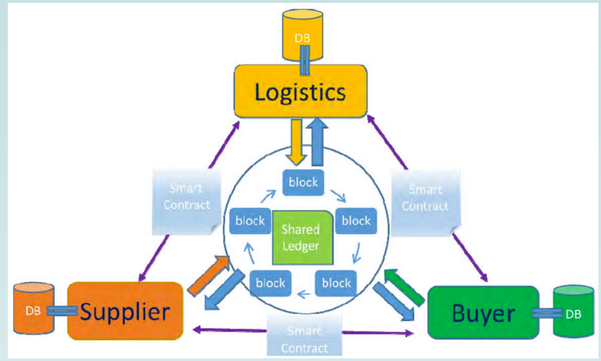

Figure 4: The Implementation of Blockchain in Supply Chain Logistics[8].

Future

As we see with IoT devices, the usage of blockchain and smart contract technologies will become more widespread, especially when is comes to their use in ensuring the secure and transparent passage of development aid to those in need.

When the benefits of blockchain technology becomes more widely realized, its implementation will be seen across many different industries by corporate entities. For example, blockchain is anticipated to revolutionize the semiconductor chip industry. Recently, there has been a big shortage of semiconductor chips. This was exacerbated by the US's ban on foreign semiconductors. Blockchain technology can help track those bad faith actors who try to get around this ban and avoid sanctions. However, as blockchain is a decentralized ledger, there are questions as to whether these transactions can be regulated and who will regulate them in the future.

Acknowledgements

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