Overview of cases

Cash transfer programs: pros and cons

CTPs improve purchasing flexibility as they allow recipients to obtain goods and services of their choice directly from local markets and service providers. This bears the potential of significant reductions in costs and time for delivering humanitarian aid, too. Also, it is often quicker to provide cash to affected people than to implement a commodity-based response which requires reception, sorting, warehousing and distribution.

However, CTPs can face several challenges that hinder transferring funds from HOs (or donors) to beneficiaries effectively, efficiently and transparently. First, as CTPs often target people with minimum access to (working) (a) financial systems and/or (b) data infrastructure, moving funds through banks' transferring systems or mobile payments may not always be feasible. According to Hallwright & Carnaby (2019), 52% of refugees in Bidibidi Refugee camp in Uganda were not able to conduct the necessary registration process to sign up to a Mobile Money or Bank account. Second, the inclusion of (often multiple) intermediaries for international money transfer (as in CTPs) implies transfer fees. Third, transparency to show aid has arrived where it was supposed is a problem. It is estimated that around 30% of development aid does not reach the correct destinations because of corruption (Economist, 2017). Results of a survey suggest that due to the above-mentioned challenges, support for CTPs has become 'modest and fragile' (Talbot & Collin, 2016).

Case 1 - UN WFP Building Blocks in Jordan

The UN WFP has been the leading HO in the adaption of cash transfer programmes and in the introduction of blockchain for such purposes. The UN WFP project 'Building Blocks' used an Ethereum-based blockchain (four nodes and one controlling entity) to distribute the equivalent of $ 1.4 million USD in food vouchers to more than 10,000 Syrian refugees living in the Azraq camp in Jordan in May 2017 (UNWFP, 2018). In this pilot, UN WFP registered the funds allocated to each individual on a blockchain. Thereafter, families could, use a biometric recognition device and to 'shop' according to their budget on affiliated markets. The biometric scanner checks the blockchain database to both confirm the identity and the credit in the account.

Case 2 - IFRC blockchain in Kenya

In May 2018, the IFRC in collaboration with the Kenya Red Cross conducted the Blockchain Open-loop Payment[1] pilot project in Oldonyiro and Sericho wards at Isiolo County, Kenya (IFRC, 2018). The pilot Project (Multichain, four nodes with three controlling entities) aimed to assist a total of 2,100 households affected by drought through Red Rose. Among the affected communities were pastoral community that move around and one of the challenges was limited data coverage in the region.

Architecture of studied blockchain pilots

[1]Piloting of blockchain technology for CTPs by other HOs such as UN WFP primarily focuses on closed-loop payment mechanisms such as e-vouchers where payments are linked to merchant specific outlets and can only be used to make purchases from those merchants

Figure 1 illustrates the architecture of studied blockchain schematically. The figure is developed based on the information of studied cash transfer programs.

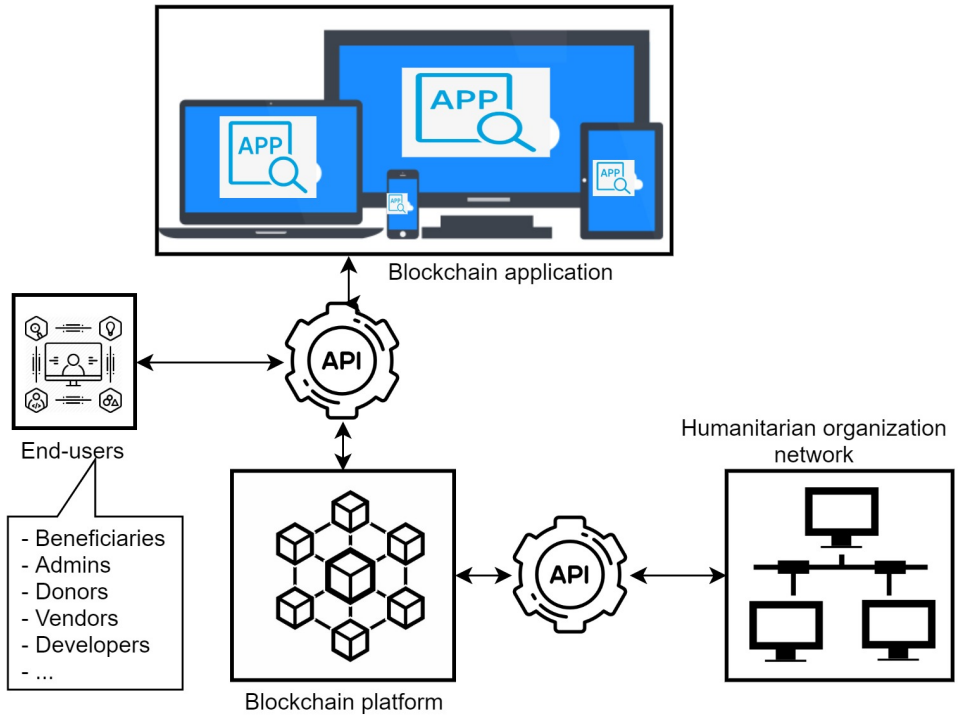

Figure 1. Studied blockchain projects' architecture (derived from cash transfer programs)

1. Details of case study findings

Contextual requirements

One main contextual consideration derived from our interviews was the ability to work in places with constrained or no data **infrastructure**. According to interviewees, in the humanitarian contexts, supporting transactions for recipients without cellular-data (i.e., payment functionality for when recipients are offline) is a critical design consideration. While some interviewees experienced no-internet or no-power contexts (IFRC represenatatives), one interviewee mentioned a targeted group that had access to shared mobile phone and thus, routinely had access to intermittent cellular data. The challenge would be worsened when vendors had no consistent data access, as this hindered transferring processing burden to the vendors device in recipient-offline payment methods.

> Electric power in Isiolo County was limited, with frequent outages. Internet connection was only available through Safaricom hotspots, which were cumbersome and slow. Being able to collect data offline and upload it later when connectivity was available was a critical feature (IFRC, 2018).

> Companies develop the solution however in reality these solutions were nowhere near being ready to be applied in the context [that] we were working [...] we missed the offline piece! We wanted to work %100 offline. (IFRC representative)

From interviewees' viewpoints, a successful solution not only should work in low-connectivity conditions, but also should be effectively accessible to **end-users** with minimal to no technical literacy. According to interviewees, the projects should be embraced by the targeted community, easily deployed, and apt to support the most vulnerable members of the targeted community. Our interviewees priority had been to make the end-users' interface simple and easy to navigate. Furthermore, it had been important for interviewees that first, to implement the system in places where at least a part of technology had been introduced before: '*a key factor underlying the pilot project's success was the widespread availability of mobile money networks in Kenya (IFRC, 2018)*'. Second, beneficiaries experience very few changes when using newly developed systems. We found that very few changes were made to the beneficiaries' side in both pilots as the blockchains were operating in the backend: '*the beneficiaries' experience remained almost the same as before (IFRC representative)*'.

The word 'ethical concerns' was repeated several times in our interviews. We found that one critical **ethical aspect** was to '*do no digital harm*', and to recognize the need to do no harm as a multilayered and multi-dimensional concept. First, interviewees had to make sure that vulnerable people can access the system. Second, delays in delivering assistance due to technical problems was counted as digital harm, according to interviewees: '*Four weeks left in a six-month [duration] project we lost our blockchain provider [. . .] and 2000 families [in Kenya] waiting for cash transfer because they were [already] noted [. . .] everybody started to get worried (IFRC representative).* Third, designs should have ensured that undue disclosures of personal data for already vulnerable people do not make them even more exposed.

Another ethical aspect referred to the challenges in projects for capturing the legitimate informed and sustained consent. We found from our interviews that through a lack of meaningful consent, accountability might be undermined. In the IFRC's report, they highlight that for beneficiaries in the Open Loop Cash Transfer project, the consent process was uncontroversial: '*[. . .] had beneficiaries not consented they would have not received assistance (IFRC, 2018)*'. Furthermore, the studied pilots ran on private, permissioned platforms and according to our interviewees, beneficiaries and local communities were mostly unaware of the back-end blockchain system. This raised questions about the nature of '*meaningful consent* (IFRC representative)'. Interviewees mentioned that informing beneficiaries about the technology and its implications, involving them in the design stage, and publishing lessons learned regarding how blockchains directly or indirectly impact the assistance can help to address ethical dilemmas.

> End users should be involved in the conceptualization and design phases of blockchain projects, since acknowledging a respect for privacy is not the same as protecting civilians and vulnerable populations.

We found **stakeholders**' diversity as another critical design aspect. According to our interviewees, decisions about projects design have repercussions on the outcomes and thus, clear roles and responsibilities for all stakeholders must be set out from the beginning of projects (Coppi & Fast, 2019). For instance in the Open Loop Cash Transfer project, the project's team engaged with beneficiaries and authorities at different levels to request and obtain the necessary authorizations, and to inform them, as main stakeholders, about the modalities of the new initiative (IFRC, 2018). According to interviewees, initiatives for having stakeholders informed would avoid pathways which could lead to an ability to monitor individuals' actions, further skewing the balance of power in the humanitarian field and potentially resulting

in surveillance-like systems. Furthermore, such initiatives enhanced collaboration, effectively improved the process of building the architecture and helped to tailor the project to local requirements.

Technical requirements

According to interviewees, a key technical consideration was to determine the level of **decentralization**. We found that interviewees talked about decentralization in two aspects namely permission and deployment. However, the rationale for choices that they had made for the pilots was unclear. One common perspective among interviewees was that private or permissioned blockchains support faster transaction times. Maybe that justifies why the studied pilots had only one writer and systems were not distributed. However, one interviewee mentioned that the long term value of having a blockchain-based system could be maximized from using a platform that is open and as flexible as possible: '*Of course we could do all of what we're doing today without using blockchain (UN WFP representative)*'. They found that several potential issues could not be identified in the pilots as a result of using private permissioned blockchains.

Another technical aspect which we could verify in our interviews referred to **key management** and digital identity, although the coverage was not wide. Apparently, the IFRC pilot experienced some challenges and they could test only basic elements of digital identity: beneficiaries profiles and IDs were generated (based on government IDs), stored and managed in one component owned by a business vendor. For the Building Blocks project, the system used digital IDs generated by the WFP stored in local computers. However, according to interviewees, the designs should aim for allowing beneficiaries to manage and maintain their own personal information. We found that IFRC has started to exploring 'self-sovereign' digital identities (i.e., empower beneficiaries to decide which relevant information to share with each service provider) for future projects (IFRC, 2018).

We investigated the **data** aspect in our interviews and documents with respect to a) what kind of data to be stored and b) where to store the data. According to our interviewees, a common practice was to store hashed (raw) data, metadata, and some small-sized public data on-chain and to keep large or private data off-chain. For the studied cases, humanitarians used blockchain to record transactions, which meant that only a relatively small amount of the data associated with the transactions was stored directly in the blockchain ledger itself: '*The blockchain recorded cash disbursements from the data management system, providing an additional layer of assurance that transactions were accounted for (IFRC, 2018)*'. Due to the (typically) limited size of the data store provided by blockchains, an off-chain data store was necessary to store other data associated with the transaction (which might be much larger). The off-chain data was kept separately from the entry in the blockchain ledger, but was referenced by the entry: '*Records were viewed via a custom-built interface, which could then be compared to the built-in audit logs available from the data management platform (IFRC, 2018)*'. This approach helped to a) avoid overwhelming the blockchain ledger with large volumes of data and b) provide capacity to take many data forms depending on the nature of the data.

The **privacy** aspect was mentioned closely to **data** several times in our interviews. We found that our interviewees had adopted a cautious approach to data, choosing to limit personal data stored on the blockchains. One interviewee mentioned that a series of factors, including the introduction of European Union General Data Protection Regulation (GDPR) and data breaches within and outside the humanitarian system have combined to raise awareness regarding privacy: '*data protection and privacy must*

be incorporated at all stages from design to implementation, and at the project, institutional and systems levels (UN WFP representative'. As a result, in both studied pilots, very limited information and no personal information was recorded on the blockchain to ensure that data was protected while the risks and benefits of the technology could be explored: '*the pilot project used a permission based private blockchain to keep full control of the privacy and security of data (IFRC representative)*'. However, reports show that due to the privacy concerns and '*lack of buy-in from beneficiaries and third parties (IFRC, 2018)*', business partners in pilots had no choice rather than writing on the closed blockchain for those actors. In practice, this meant that the technology provided little more utility than a difficult to alter database. Furthermore, we noted that interviewees focused on **privacy** as a contextual requirement rather than a technical requirement, although the distinction remained fuzzy in several places: '*cash transfer programs involve people who are vulnerable. As such, we considered it an unacceptable risk to put any personally IDs on the blockchain, even in an encrypted form (IFRC representative)*'. Therefore, we suggest considering **privacy** in the contextual requirement block (cf. Figure 2).

Scalability is a design aspect that emerged from our interviews. According to our interviewees, one effective strategy would be to think of scalability in early design stages rather than leaving it for the pilot evaluation stage: '*the plan was to evaluate the pilot to make recommendations for future utilization and scaling potential which was not a good idea (UN WFP representative)*'. For our interviewees, thinking of scalability ahead meant looking for the resources to be able to plan longer-term, and support how they can scale up the programme in the targeted region or somewhere else. For instance, UN WFP's estimation for blockchain pilot was that once the pilot would be fully scaled up (in late 2018), it will pay only $150 in monthly financial service fees, compared to $150,000 before (Pisa & Juden, 2017). However, going from pilot projects to scale has taken longer than many realized, as UN WFP still grapple with challenges related to data privacy, operational resiliency, and governance (Coppi & Fast, 2019).

Organizational requirements

According to interviewees, existing **databases** of organizations should be considered in the design strategy. These databases often include metadata as well as systems of record for organizations' applications. The significance of such consideration is the feedback loop in the analytical processes for blockchain systems provided by a potential direct flow of stored data into data integration or data repositories. According to interviewees, the data that was connected to their blockchain pilots included: transactional data, application data, and/or log data. Interestingly, our interviewees mentioned that a major challenge in their pilots was to effectively and efficiently link private blockchains to their databases for 'application data' (i.e., data used by or produced by organizations' applications functionally or operationally) to verify, add value and/or drive insights. The challenge referred to security and availability: '*When we scan the beneficiaries' eyes, the blockchain authenticates the beneficiaries' identity through a linked relational database with hashed information on beneficiaries and their entitlements. The link didn't work well sometimes due to several reasons (UN WFP Representative)*'. In the IFRC's case, a new data management system was developed and linked to the blockchain which was costly. Interviewees mentioned that the problem could be addressed if the organizations' databases had been considered upfront in the design phase:

> For a federated organization like the IFRC whose members utilize a variety of platforms for data collection and management, the modular approach used to develop the solution architecture provides flexibility to consider different applications to fulfil the required capabilities. The solution architecture also allowed to demonstrate that blockchain solutions can be implemented in lighter and less complicated manner, depending on the use-case and required capabilities (IFRC, 2018)

Another key organizational requirement in our interviews was **interoperability**. According to Coppi & Fast (2019), blockchains have not yet '*overcome the siloed nature of the humanitarian system, resulting in limited interoperability as the design and development of these projects occurs in relative secrecy*'. Our interviewees confirmed that humanitarian blockchain projects operate in silos and in relative secrecy. They also noted that such an approach limits the possibilities for developing interoperable systems across organizations and across humanitarian sector uses. According to our interviews, issues related to **intellectual property** hindered an effective long term vision for interoperability: '*Several start-ups sent proposals to us. However, we didn't want to be a test-bed for them because at the end of the day they could take their product [...] and we end up with nothing while we are paying for it (IFRC representative).* Interviewees found that one solution would be to go for an open source approach which could potentially enable interoperability through adopting open standards: '*outside of the aid sector, many private and public initiatives have consciously adopted an open source approach and allowed the public to study, edit, copy and critique their code and architecture (UN WFP representative).* As we found intellectual property a key design aspect in our interviewees' viewpoint, we suggest to consider it as a separate aspect in the organizational requirements block (cf. Figure 2).

Problems associated with **regulations** were noted several times in our interviews. Our interviewees considered the absence of effective regulatory frameworks in the humanitarian sector as an opportunity and a risk, while the focus on latter was more than the former. One common concern of interviewees was that at the international level, multiple legal frameworks can apply, requiring humanitarian organizations to involve legal counsel from the early design stages. Our interviewees mentioned that before starting their projects, they had to proactively analyze and clarify which regulatory frameworks had been applicable at various levels and with relevant authorities: '*we needed specialized legal counsel from someone who has the time and ability to conduct thorough research at the early stages of platform design to determine the applicable legal frameworks and identify potential legal and regulatory risks [...] it was not easy and there were many knowledge gaps (IFRC representative)*'. Without such consultation, our interviewees confirmed that regulations uncertainty can be a major roadblock to the use of blockchains in the humanitarian sector.

> The blockchain is not yet regulated everywhere, specifically targeted countries by the humanitarian sector, by international or national laws as a cross-border network. Here, protection, privacy and security concerns are huge as long as data is managed on a global decentralized network, especially in locations with more autocratic governments, less corporate regulation, and highly-vulnerable populations. (IFRC representative)

Some parts of **regulations** should include rules related to in and out mechanisms, according to our interviewees. A finite set of participants and roles may start with the network. However, as time progresses, new participants may want to join or some others may want to leave the network. Thus, it is necessary to consider the mechanics of changes in membership, such as access to (shared) data. The design should also consider the member type, as interviewees argue that the role and/or type of a mem-

ber may change. Such considerations may imply changes when developing technical components of a blockchain project. As a result and given the focus of **regulations** aspect on legal frameworks, some of our interviewees disentangled the aspect of **in and out mechanisms** to put more emphases on it and highlight the potential impact on technical design. Thus, we suggest to consider it as a separate aspect in the technical requirements block (cf. Figure 2).

Maintenance and **support** were used interchangeably by our interviewees. However, we also found that support can have multiple implications such as cultural and technical. For instance, some interviewees mentioned that within organizations, challenges of implementation were typically due to internal processes and lack of understanding among the organizations' personnel rather than the technology, which created a perception of risk and led to a lack of support: '*pilots couldn't easily get to scale because of internal blockages (UN WFP representative*'. The technical support, another aspect, referred to considering potential requirements in the organization to technically support blokchain projects, in terms of IT teams, and infrastructure. In one case, the business partner assigned a developer to stay in the humanitarian organization to support the pilot implementation.

IT knowledge and skill were key organizational requirements that emerged from our interviews. According to our interviewees, educating humanitarians and other stakeholders about blockchain's potential uses, and changing the organizational culture proved to be challenging for the pilot programmes: '*[. . .] indeed integrating blockchain technology into existing organizational processes is the hardest work. It's impossible to expect people to get on the high-speed blockchain train without prior knowledge of station, train, etc. [. . .] We have to help them to get into the station first (WFP representative)*'. Some interviewees had to spent significant time educating internal stakeholders about the basics of the technology, which was unexpectedly time consuming and resource demanding. Interviewees also highlighted that the IT knowledge and skill of personnel in the country level should be considered during the design phase, and probably a pathway to educate and develop required skillset should be developed at early stages:

> at the developing country level, they aren't exposed to information about blockchain in the same way. This is a risk, but it's also something that should be put into the design and piloting process. As part of the country-based staff [in the organization], I have to figure out how to be an expert in explaining blockchain to the country-level staff. (UN WFP representative) (. . .)

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