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Research Report

Blockchain and distributed ledger technologies in the humanitarian sector

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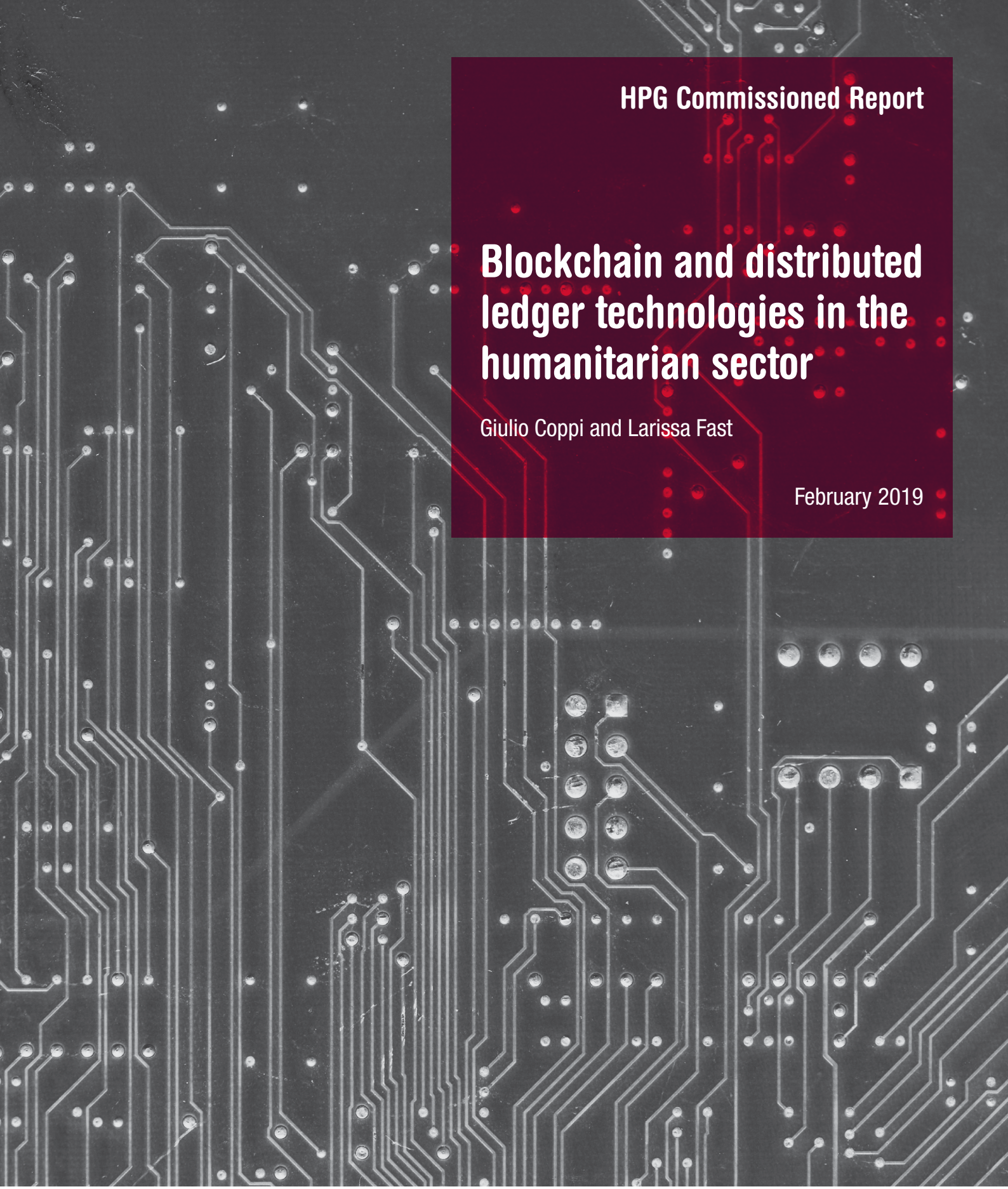

HPG Commissioned Report

Blockchain and distributed ledger technologies in the humanitarian sector

Giulio Coppi and Larissa Fast

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Acronyms

API	Application programming interface
CBT	Cash-based transfers
DLT	Distributed ledger technology
FCA	UK Financial Conduct Authority
GAHI	Global Alliance for Humanitarian Innovation
GDPR	European General Data Protection Regulation
HPG	Humanitarian Policy Group
IBAN	International Bank Account Number
ICT4D	Information and Communications Technologies for Development
IDS	Institute of Development Studies
IFRC	International Federation of the Red Cross and Red Crescent Societies
IoT	Internet of things
IP	Intellectual property
KRCS	Kenya Red Cross Society
NGO	Non-governmental organisation
ODI	Overseas Development Institute
P2P	Peer-to-peer
PII	Personally-identifiable information
POS	Point of sale
PPP	Public–private partnerships
SMS	Short message system
UNOPS	UN Office for Project Services
WFP	World Food Programme
WVI	World Vision International

Glossary

Digital wallet	An electronic device or online service that holds assets (funds, tokens, vouchers, or cryptocurrencies) on behalf of a user. The same device or system often allows the individual to make electronic transactions.
Distributed ledger technology (DLT)	'An umbrella term to designate multi-party systems that operate in an environment with no central operator or authority, despite parties who may be unreliable or malicious' (Rauchs et al., 2018: 15).
Fiat currency	Fiat currencies are backed by governments and managed by central banks, whereas cryptocurrencies – such as Bitcoin or Ether – are not. An exception is the commonly-called stable-coins, which are digital currencies pegged to the value of traditional assets such as national currencies.
Internet of Things (IoT)	A network of devices that allows them to connect, interact, and exchange data directly. IoT systems allow traditionally non-connected devices to communicate among each other, even in the absence of connectivity.
Last mile	A commonly-used term in the telecommunications industry that refers to the final 'mile' (or kilometre) that ensures a connection between the business and the customer, whether related to mobile phone coverage, internet connectivity or other services. The last mile is also usually the most expensive to develop. In humanitarian applications, the same expression refers to the last stretch of a journey to reach the most isolated communities.
Permissioned and permissionless ledgers	Permissioned ledgers only allow modifications by those with prior authority ('permission') to make changes. This requires pre-identification or vetting. In contrast, anyone can make changes to permissionless ledgers.
Smart contracts	Smart contracts define a set of actions that will automatically trigger a new series of actions. In the aid sector, this could enable the automated disbursement of funds from a donor after the verified completion of a set of activities (see Verhulst, 2018; Zwitter and Boisse-Despiaux, 2018).
Testnet	Refers to a blockchain or DLT network, alternative to the main network, used for testing experimental features or use cases. Operations on the testnet usually do not involve any real transfer of assets of funds (see https://medium.com/compound-finance/the-beginners-guide-to-using-an-ethereum-test-network-95bbbc85fc1d).

A note on terminology

We made a series of decisions related to the use of terminology (see definitions in the text and in the Glossary) in drafting this report. On the one hand, the term 'blockchain' is better known and often serves in current debates as a synonym for the whole family of distributed ledger technologies (DLTs). Some interviews used 'blockchain' in this way, in its broadest sense. On the other hand, technology experts consider blockchain systems to have a set of specific, unique features: these refer to 'a chain of cryptographically-linked data blocks to efficiently and securely timestamp digital data in distributed systems' (Rauchs et al., 2018: 15). In fact, these two concepts are sometimes treated as equal, even in technical literature on the subject (Atzori, 2015; Cong and He, 2018; Nelson, 2018: 4).

This research, however, revealed that many projects currently deployed in the humanitarian sphere fall too far apart on the DLT spectrum to define them all as 'blockchains', especially when their schematics and development code remain hidden. We thus adopt the term DLTs by default, except when referring explicitly to projects or platforms that claim to possess the key components of blockchain systems. Explanations of DLT and blockchain appear in the section below entitled 'What are DLTs and what is blockchain?'.

Executive summary

Blockchain and the wider category of distributed ledger technologies (DLTs) promise a more transparent, accountable, efficient and secure way of exchanging decentralised stores of information that are independently updated, automatically replicated and immutable. The key components of DLTs include shared recordkeeping, multi-party consensus, independent validation, tamper evidence and tamper resistance (Rauchs et al., 2018). Building on these claims, proponents suggest DLTs can address common problems of non-profit organisations and non-governmental organisations (NGOs), such as transparency, efficiency, scale and sustainability (Accenture, 2017).

Where does the potential lie for DLTs in the humanitarian sector?

To date, there is little supporting research or evidence about the impacts of DLT projects that have already been implemented, and existing research tends to focus on how the technology works, rather than its humanitarian applications. Current humanitarian uses of DLT are similar to those identified for development and social impact. Common uses include financial inclusion, land titling, remittances, improving the transparency of donations, reducing fraud, tracking support to beneficiaries from multiple sources, transforming governance systems, micro-insurance, cross-border transfers, cash programming, grant management and organisational governance. Most of the improvements brought by DLT in these cases involve back-end processes, rather than impacting on end-user experiences. Existing projects report limited reference to accountability and protection frameworks inspired by humanitarian principles. For the most part, publicly available discussions remain in the hypothetical stage of how DLTs *might* be used or what their potential advantages are, adding to its hype but not to the evidence. The report highlights current uses, knowledge and evidence gaps around DLT for humanitarian purposes, and outlines a series of recommendations.

Current use cases of DLT in the humanitarian sector

The report draws on more than 35 interviews and written submissions from humanitarian DLT or technology experts and individuals involved in humanitarian DLT use cases. It features five illustrative examples of different types of DLT and how they have been applied in the humanitarian sector.

- **The World Food Programme's Building Blocks** project uses blockchain technology (Ethereum, four nodes and one controlling entity) to make its voucher-based cash transfers more efficient, transparent and secure, and to improve collaboration across the humanitarian system.
- **The Start Network and its member organisations Dorcas Aid International and Trócaire partnered with Disberse,** a for-profit financial institution for the aid sector, on pilot programmes using DLT (Ethereum-based, two and three nodes and one controlling entity) to increase the humanitarian community's comfort with the technology.
- **Helperbit** uses the Bitcoin public network to create a decentralised, parametric peer-to-peer insurance service and donation system (multi-signature e-wallet) to change practices of humanitarian assistance both before and after an emergency.
- **Sikka**, a digital-assets transfer platform (Ethereum, one node and one controlling entity), was created by World Vision International Nepal Innovation Lab to address the challenge of financial access during times of crises for financially marginalised and in-need communities.
- The **IFRC and Kenya Red Cross implemented the Blockchain Open Loop Payments Pilot Project** (Multichain, four nodes with three controlling entities), through Red Rose, to explore how blockchain could increase the transparency and accountability of cash transfer programmes, including in relation to self-sovereign digital identities.

Early lessons and what do they tell us?

The five use cases, interviews and related literature underscore lessons for the project, policy and system levels. **On the project level, motivations for adopting DLT varied, but were shaped more by programmatic and organisational considerations than technical specificities or end-user needs.** These motivations included the desire to lead the way in testing new technology, as well as to capitalise on the perceived benefits of DLT, namely increased transparency, accountability and efficiency. Based on the initial organisational motivations, **benefits from using DLT related to process improvements and back-end efficiencies**, such as reducing paperwork, removing intermediaries and facilitating audits, though actual financial advantages remain to be proven, especially at scale. Since **none of the current DLT projects is fully end-to-end or digital**, knowledge gaps remain as to how these advances would affect DLT projects in the humanitarian sector. Other potential trade-offs include assuming risks when third parties, such as governments and the private sector, become involved in the registration process or in collecting, imputing, storing, processing, and protecting data. Finally, **data protection and privacy must be incorporated at all stages and at all levels**; at present, most organisations seem unclear on how to do this and, as a result, tend to limit the amount of personal data stored on DLTs, which in turn limits the type and kind of services that can be provided through the system.

Lessons at the policy level are primarily concerned with the individuality or specificity of the programme or organisation. Within organisations, challenges of implementation were typically due to internal processes and lack of understanding among an organisation's personnel rather than the technology, which creates a perception of risk and leads to a lack of support. Other difficulties exist between organisations and their partners, particularly on issues of intellectual property and project governance. Internal and external challenges result in delays and additional costs and can undermine efforts to scale up projects and make them sustainable. Moreover, **DLT does not overcome the siloed nature of the humanitarian system**, resulting in limited interoperability as the design and development of these projects occurs in relative secrecy, unlike many of the public and private sector initiatives that are open source. Finally, **the absence of robust regulatory frameworks has resulted in the applicability of multiple legal frameworks, and highlights the need to involve legal counsel from the beginning of projects.** In low- and middle-income countries, this lack of legal framework can facilitate short-term wins, particularly in situations where governments may discourage electronic cash transfers, but the removal of intermediaries and altered power dynamics may result in unintended consequences that could endanger end users as well as future projects.

Perhaps the most important, though least tangible, of the lessons from this research applies at the system level. **Although transparency and trust are often cited as the most significant benefits of DLTs, this research suggests that, at the system level, the improved efficiency, bureaucracy and project cost savings brought about by DLTs have proved to be more important for humanitarian actors.** A radical approach to transparency, in fact, presents both advantages and pitfalls for humanitarian actors. Greater transparency would allow individuals and organisations to ensure their money is being delivered to the target population and would permit the target population to verify they received the correct funding, and manage and trace their own transactions. However, an analysis of the dynamic and constantly changing nature of the humanitarian 'last mile' suggests that, although increased transparency is commonly linked to increased trust in the humanitarian sector, it could also potentially undermine this trust. Similarly, **accountability may also be undermined through a lack of meaningful consent and engagement in project design from end users**, which could exacerbate power imbalances between aid organisations and their beneficiaries and facilitate a surveillance-type system that could be used to harm, rather than help, vulnerable populations. To prevent this, **the humanitarian sector must understand how invisible biases and assumptions underpin automated systems and take fully informed decisions to mitigate these risks.** This requires, among other things, incorporating humanitarian principles into digital products and programmes. Finally, **DLT programmes have tended to adopt a reformative, rather than transformative, approach and are at risk of reproducing many of the underlying power dynamics, hierarchical structures, funding flows and deployment strategies that already exist in traditional humanitarian programmes.** It is still unclear whether current systems based on DLT would run parallel to existing financial and administrative structures, or rather replace and automate the entire system, and whether new actors and partners would be integrated into the humanitarian coordination system or be seen as suppliers for the existing system. Embracing a DLT vision for the humanitarian future implies designing from the outset a new equilibrium

that distributes power more equally. The first step towards this goal is to open a public and inclusive discussion over how this could and should be done.

What should guide our current thinking and future action?

Moving forward, this report offers seven sets of recommendations to address the challenges that must be overcome before DLTs can be ethically, safely, appropriately and effectively scaled in humanitarian contexts:

- **Aid actors should consider transparency not only as an outcome, but also as a necessary precondition at the inception of (new) DLT projects.** This entails informing end users about the technology and its implications and involving them in the design stage, shifting to an open-source mentality and publishing lessons learned and evaluations of how DLTs directly or indirectly impact on project outcomes.
- **Humanitarians using emerging technologies, especially DLTs, should base their initiatives on evidence.** The decision to use DLTs should result from detailed analysis, based on existing and emerging research, of the problem and comparable solutions, including non-DLT options.
- **Treat the innovation of back-end processes as an opportunity, and front-end ones as a challenge.** Most improvements come in streamlining internal organisational processes, though more research is needed on the advantages of different platforms.
- **Humanitarians must carefully consider the design of DLTs, since this fundamentally shapes much more than the way projects are implemented.** Decisions about platform design have repercussions on almost all aspects of DLTs, and clear roles and responsibilities for all stakeholders must be set out from the beginning of projects.
- **The legal and regulatory space for DLTs represents a significant knowledge gap. Donors and humanitarian actors need to support the development of knowledge in this area.** Aid actors should push for clear and reliable guidelines, comply with the strictest regulations and advocate for clearer, more transparent regulatory frameworks.
- **To 'do no digital harm', include communities, recipients and users at the drawing board stage, and recognise the need to do no harm as a multi-layered and multi-dimensional concept.** End users should be involved in the conceptualisation and design phases of DLT projects, since acknowledging a respect for privacy is not the same as protecting civilians and vulnerable populations. Grievance and reparation policies and mechanisms should be developed.
- **Humanitarian actors need to work towards a transformative vision of DLTs and move beyond their reformative potential.** DLTs offer a significant opportunity to transform the humanitarian system into one that is fairer and more distributed, with local communities and partners in primary roles and new ways of helping people affected by crises.

1 Introduction

In the spring of 2018, the Global Alliance for Humanitarian Innovation (GAHI) commissioned a report to inventory and establish the 'state of play' of current uses of distributed ledger technology (DLT, the most common example of which is 'blockchain') for humanitarian purposes – that is, to support the provision of assistance, services or protection to populations affected by conflict, war, or natural disaster.

A significant and complex literature describes the different models, processes and lessons learned in designing and implementing DLTs for commercial, financial and logistical purposes. Unfortunately, few researchers have addressed how humanitarians are testing DLTs. As a result, most available resources offer primers (e.g., Arkin, 2018; Nelson, 2018), or explore the potential of blockchain (e.g. Thompson, 2018), the panorama of existing initiatives (Ko and Verity, 2016), or the challenges faced in the process (Humanitarian Advisory Group, 2017). They rarely reach the level of robust evidence of impact that one might see with other, more established, technologies and processes used in humanitarian action.

This report contributes to filling this evidence gap by:

- identifying knowledge and evidence gaps regarding the uses of DLT, as well as potential risks, pitfalls, opportunities and advantages based on existing pilots and initiatives; and
- outlining a series of recommendations aimed at mitigating the risks and maximising the use and benefits of DLT, particularly related to issues of governance, implementation, and principles and guidance.

1.1 Scope

This report focuses on existing, ongoing or completed pilots and initiatives and only briefly mentions anticipated or potential use cases (e.g., use of DLT to assist with 'humanitarian passporting' (Shah, 2017) or credentialing). In the humanitarian sphere, use cases primarily relate to asset transfers (e.g. direct giving, voucher or cash transfers to those in need of humanitarian assistance), financial transfers (often internal, from one unit of an organisation to another in a separate country) or supply chains. While several existing use cases have or are in the process of documenting lessons, there are few available evidenced use-cases of DLTs. Moreover, many of those involved in implementing or researching pilots are restricted from sharing technical or internal information, including via non-disclosure agreements. As discussed below, the access restrictions in many of these agreements protect proprietary and commercial information, but make it difficult to assess the viability and scalability of DLT for humanitarian purposes, or determine the ways in which DLT use cases may (or may not) constitute humanitarian experimentation (Sandvik et al., 2017). Consequently, the publicly available evidence around DLT use cases, including blockchain, is sparse and mostly relies on qualitative data.

1.2 Methodology

This report reviews existing literature about DLT and blockchain, including their applications in the humanitarian sector. It draws on over 35 interviews with and written submissions from humanitarian DLT or technology experts – convinced and sceptical – and individuals directly involved in humanitarian DLT use cases. Interviews took place mainly in June and July 2018, with some exchanges extending into October. In some cases, we also engaged in extended email conversations with interviewees. Interviews typically lasted 60 minutes and followed a semi-structured format. Questions covered project details and purpose, technical specifications (where possible or available), project governance, data protection and privacy, impact, and lessons learned. In developing the interviewee list, we prioritised individuals and organisations with existing or completed DLT use cases in the humanitarian sector. A list of interviewees and their affiliations appears in the Appendix. To encourage frank discussions, we indicated we would not cite any individual by name or affiliation in this report except with permission.

Importantly, the interviewee list does not include any end users or crisis-affected people. We made this decision early in the research phase, realising that projects typically did not inform local communities of the specifics of the technology to be deployed.

Gathering feedback from these groups would have required a different approach, to be agreed, planned and implemented with implementing organisations to seek informed consent. This was not possible given the timeframe and scope of the research.

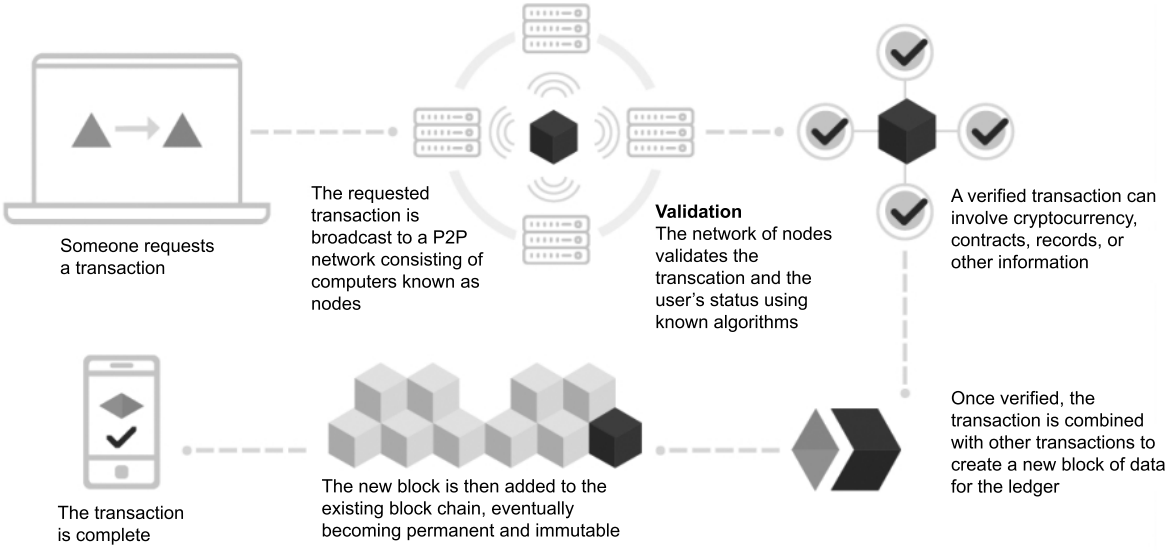
Wherever possible and available, we have consulted published and unpublished confidential lessons learned documents. Unless otherwise cited, all materials derive from interviews or reports shared with us during the research process.

2 What are DLTs and what is blockchain?

Distributed ledger technologies (DLTs) are essentially ledgers – collections of accounts of information that are often, but not exclusively, financial – that are independently and identically replicated (or 'distributed') across multiple computing devices or entities, known as 'nodes'. As a result, each ledger is copied again and again, creating multiple, identical copies of the ledger. Data stored via DLTs are not stored in a centralised way but instead are decentralised across nodes and are simultaneously and independently updated. The independent updates and decentralised storage are what purportedly provide DLTs with characteristic advantages, notably their transparency and security. Because data is visible via nodes, they are transparent; because they are automatically replicated and impossible to manipulate or tamper with across all copies and nodes, they are immutable and therefore secure. Thus, having more nodes increases the security and transparency of the data stored on the DLT (see explanations in Nelson, 2018; Rauchs et al., 2018; Ray, 2018). These qualities, in turn, enable additional features of DLTs often touted as key advantages: accountability (because of the transparency and immutability of the transactions) and the possibility of 'trust' in the system and underlying code, even without knowing or trusting the entities making the transactions.

Blockchains are one form of DLT. The 'Bitcoin Whitepaper' (Nakamoto, 2009) describes the origins of blockchain and outlines a way to transfer assets among individuals or entities – referred to as a 'peer-to-peer' (P2P) network. The network aimed to overcome the vulnerabilities of centralised systems without incurring the risks affecting traditional economic models (for further details, see Lehdonvirta, 2016; Maupin, 2017; Tama et al., 2017; Tapscott and Tapscott, 2017). A primary difference between blockchain and other forms of DLT relates to the storage of data. In a blockchain, data is stored as groups, or 'blocks', of information. New transactions can only add information to the 'chain' of past transactions; it is impossible to delete or modify information previously stored 'on the chain' because blocks are replicated across multiple ledgers. As Ray (2018) suggests, 'Blockchain technology is …

Figure 1: Blockchain illustration



Source: Adapted from UNDP (2018).

Box 1: The properties of DLTs

According to Rauchs et al. (2018: 24), DLTs must be capable of ensuring the following criteria are met, either in the existing system or with minimal changes to the system. These include:

1. A set of authoritative records (the ledger) is shared across multiple parties/nodes ('shared recordkeeping').
2. All parties agree on this set of shared records ('multi-party consensus'), either in a permissioned or permissionless system.
3. Parties are able to independently verify the transaction records on the ledger ('independent validation').
4. Parties are able to detect any unilateral or non-consensual changes to transactions ('tamper evidence').
5. Individual parties are unable to easily or unilaterally change the transaction history of the ledger ('tamper resistance').

well-suited for recording events, managing records, processing transactions, tracing assets, and voting'. This set of linked blocks of information creates a chain of blocks – a 'blockchain' - but not all distributed ledgers employ a chain of blocks to provide a set of shared, secure, and distributed, independently validated records.

DLTs are either permissioned or permissionless, and public or private; they may also be any combination of these. Whereas anyone can make changes or additions to permissionless ledgers, permissioned ledgers only allow those with prior authority ('permission') to make modifications. Public ledgers are fully and publicly viewable, while private ledgers are available only to certain entities (Nelson, 2018). Public ledgers may have hundreds or thousands of nodes, while private ledgers may have as few as one or two. A DLT or blockchain controlled through one or a few nodes by a single entity is akin to a traditional centralised database. This removes several key functions of a DLT system, notably its transparency and security since the controlling entity can independently modify data without the checks and balances provided by a system with many controlling entities.

A decade since inception, the terminology of DLT and blockchain remains inconsistent (Rauchs et al., 2018; see Box 1 for a set of precise characteristics). For the purposes of this study, we have adopted the following definition: '[d]istributed ledger technology (DLT) has established itself as an umbrella term to designate multi-party systems that operate in an environment with no central operator or authority, despite parties who may be unreliable or malicious' (Rauchs et al., 2018: 15).

Much research on DLTs and blockchain has focused on their potential (Tapscott and Tapscott, 2017; Zambrano, 2017) and their relationship to innovation (e.g., Johansen, 2016; Tapscott and Tapscott, 2017), while others have explored ways to harness the power of this technology for positive impact (e.g., Blockchain for Good, 2016; GSMA, 2017; Humanitarian Advisory Group, 2017; Mercy Corps, 2017). Only recently has an improved awareness about the challenges and risks linked to the adoption of this emerging technology taken hold and led to a more critical body of work, including attempts at regulating ethics (Cheesman, 2017; Finck, 2017; LaPointe and Fishbane, 2018). The following section discusses current applications and challenges related to DLTs in relation to public services, social impact and development.

2.1 The use of DLTs in the public sector

Numerous examples of systems inspired by DLTs and blockchain in the public sector already exist. For example, Georgia is developing a DLT-based land registry to verify property transactions using automated 'smart contracts', in partnership with a global company called BitFury[1] (Shin, 2017). The Dutch government has created an integrated platform to highlight existing pilots and projects, many related to public services such as healthcare.[2] The Estonian government, a pioneer in adopting digital technology, has embraced blockchain to protect and ensure the integrity and authenticity of government data. KSI, a blockchain technology developed in Estonia, is central to its e-Estonia services, which cover everything from government ID to healthcare and court documents.[3]

1 See: https://bitfury.com/

2 See: www.blockchainpilots.nl/home-eng

3 See: https://e-estonia.com/solutions/security-and-safety/ksi-blockchain/

DLT also supports social impact interventions. In an analysis published in the *Stanford Social Innovation Review*, Lehr and Lamb point to the transformative potential of DLT in the philanthropic sector, ranging from donations via cryptocurrencies – either directly or via tokens, such as the non-governmental organisation (NGO) Charity:Water's 'Clean Water Coins' – to its use in improving accountability and measuring and verifying the impact of social impact investments (Lehr and Lamb, 2018). The South Africa-based ixo Foundation has used blockchain to register school attendance, making it possible to claim and release government subsidies (Schiller, 2018). The Foundation recently released a 'proof of impact' protocol that could be used to verify project impacts (ixo, 2017).

In another study (Galen et al., 2018), a Stanford team listed 193 organisations, initiatives, and projects using blockchain for social impact. The team's broad analysis illustrates the rapid uptake of this technology and its value, particularly in relation to efficiency, payments, reducing fraud and verifying records. However, the researchers conclude that only 'fifty-five percent [of these projects] are estimated to have an end impact on their beneficiaries by early 2019' and would not be rolled out in any significant way (Galen et al., 2018: 2). For non-profits and NGOs, DLT and blockchain are claimed to be particularly relevant in addressing issues related to transparency, efficiency, scale, and sustainability (Accenture, 2017).

In the international sector, DLTs have been linked to development aid in general (Haahr, 2017; Hernandez, 2017; Mercy Corps, 2017; Nelson, 2018; Pisa, 2018; UNDP, 2018) as well as specific problems, including environmental applications (LeSève et al., 2018), human trafficking and migrant children (World Identity Network, 2018) and the Sustainable Development Goals (Hernandez, 2017; Lowe et al., 2018; UNDP, 2018). Many potential and actual uses of DLTs relate to financial or administrative applications. The transparency, immutability, and verifiability of these systems are well suited to financial transactions, registries or contracts, and can reduce fraud and corruption.

Denmark was among the first countries to detail the potential of DLTs in development cooperation (Haahr, 2017), such as the use of blockchain to enable transfers of development aid directly to recipients, without middlemen or fees. A briefing paper from the Institute of Development Studies (IDS) (Hernandez, 2017) identifies a broad set of potential applications, including: microfinance, remittances and international payments; digital registries (such as land registries); aid tracking; smart-aid contracts; and P2P donations. Recognising the importance of an open and inclusive approach in developing DLTs, GSMA identified 'incorporative' platforms, which focus on administrative or financial efficiencies, as providing a way for mobile network operators and development actors to use blockchain technology (GSMA, 2017).

While a space for DLTs appears to exist in the social impact and development sectors, barriers remain. Crucially, the technology can be 'over-hyped, and solutions are sometimes chasing problems, with technologists rather than sector representatives driving development' (Lehr and Lamb, 2018). This remains a commonly identified problem, resulting in a prominent and prolific narrative of far-reaching, transformative potential with little in the way of evidence to support the hype. Sceptics often use the 'hype-without-evidence' narrative as a reason to discount blockchain and its potential. For example, an investigation into blockchain use cases (Burg et al., 2018) identified the hype-without-evidence problem. The associated blog post called for more openness about use cases and evidence related to the impact of the technology on people's lives, and outlined a learning agenda that would involve all stakeholders in a process to build evidence of impact. Yet the investigation was subsequently and misleadingly reported as 'Blockchain study finds 0.00% success rate and vendors don't call back when asked for evidence' (Orlowski, 2018), missing the primary point of the original post.

Many reports express a degree of caution regarding blockchain and recognise a series of challenges. For example, Nelson (2018) identifies the potential of blockchain and raises a series of key questions to guide its adoption, including related to the problem blockchain or DLT solutions are purportedly addressing, and whether the problem is amenable to blockchain solutions, data storage, and the digital infrastructure already present in a country. Others are more specific. Zambrano (2017) highlights barriers, particularly in the Global South, related to the availability of financial resources and local tech expertise that could facilitate the development of DLT applications addressing locally-defined needs. Many reports raise privacy and data concerns, as well as deficiencies in infrastructure, regulatory policy and legislation (Zambrano, 2017; Lowe et al., 2018). Scott (2016) goes further, underlining the 'technology-as-saviour' narrative that often pervades Information and Communications Technologies for Development (ICT4D) conversations, including blockchain, and the conservative, free-market libertarian origins of blockchain technology. He concludes that 'while the community around this technology is

enthusiastic and experimental, it is still prone towards the elitist, tech-centric outlook of disruptive technology start-up culture' (Scott, 2016: 17) and calls for more research and contextualised applications. As is evident in the discussions below, similar concerns pervade humanitarian applications of blockchain and other DLTs.

2.2 DLT and its humanitarian applications

Assessing humanitarian applications of DLTs is not straightforward. Three issues arise in the literature: first, a lack of clarity about specifically *humanitarian* applications, juxtaposed against those of other sectors; second, the disconnect between hype and evidence, related to the failure to reuse or build upon existing technology and a lack of evidence more generally; and third, a knowledge gap related to the governance and ethics of DLTs.

First, the humanitarian uses of DLT are similar to those identified for development and social impact, such as the ability to 'track and trace' transactions or goods, provide a verifiable identity, or institute automated smart contracts (Verhulst, 2018). For instance, a Mercy Corps report (2017) listed uses related to, among others, financial inclusion, land titling, remittances, transparency of donations, reducing fraud, tracking of support to beneficiaries from multiple sources, transforming governance systems, micro-insurance, cross-border transfers, cash programming, grant management and organisational governance. Dickerson (2018) records humanitarian financial and identity applications as well as property rights and supply chain use cases. Most, if not all, of these activities could be linked to both humanitarian and development programmes. The overlap between humanitarian and development applications of DLTs is unsurprising; most potential and actual humanitarian use cases are iterations of traditional commercial functions – such as financial services, information management, identity or asset management and tracking – all of which form the foundations of DLTs in use today.

In a report for the Digital Humanitarian Network,[4] Ko and Verity (2016) explored the application of blockchain technology to humanitarian action. They conclude that 'blockchain technology can be applied to humanitarian challenges, but it is not a separate humanitarian innovation in itself' (Ko and Verity, 2016: 4). Its value, they suggest, lies in the ability to improve efficiency and traceability of transactions or information flows, as well as cost savings. These uses constitute 'back-end' blockchain applications – those uses related to financial or internal processes that support humanitarian programmes – rather than the 'front-end' applications that directly touch the recipients of aid. These findings mirror those related to other sectors and exemplify the difficulty in identifying *specifically humanitarian* applications of DLTs. We return to these points in our analysis below.

One blockchain application related to international humanitarian law (IHL) currently in testing phase is Whiteflag, a protocol designed to communicate and protect information used in disaster and conflict settings, such as the locations of hospitals. Whiteflag allows combatants to 'digitally communicate pre-defined signs and signals using blockchain technology',[5] thereby facilitating deconfliction (Parker, 2018). Essentially, it allows an entity, such as a military or a humanitarian organisation, to place encrypted information (e.g. locations of field hospitals or medics, planned troop movements) on the chain and to judiciously share this with other trusted actors. The protocol would allow entities – military forces, NGOs, or the Red Cross – to securely communicate information with other verified entities in near real-time, thereby facilitating better situational awareness in evolving and dynamic environments and, ideally, minimising civilian casualties or other harm.[6] This is similar to use cases involving self-sovereign digital identity, where individuals control who can access specific pieces of information about themselves, such as educational qualifications, and work or credit history. Those involved in discussing, creating, or testing the protocol include NGOs, international organisations, militaries and commercial actors. They have extensively tested Whiteflag on the Ethereum blockchain[7] and are

4 See: http://digitalhumanitarians.com

5 See https://standard.whiteflagprotocol.net for more about the protocol and its specifications.

6 In some contexts (e.g. Syria) where medical personnel are deliberately and repeatedly targeted, medical personnel may not want to easily identify their locations. While the protocol would allow those placing information on the chain to share only with selected, trusted actors, this illustrates the need for strong accountability systems, as the approach could backfire.

7 See: www.ethereum.org

now finalising the standard and software protocol, as well as selecting use cases for further testing.[8]

Importantly, in all these examples and reports, discussions about humanitarian applications are linked to how DLTs are being or might be *used* (e.g. in humanitarian cash transfers; to track services provided to refugee populations; for crowdfunding humanitarian programmes); few reports discuss DLT humanitarian applications in relation to core concepts such as humanitarian principles (for an exception, see IFRC, 2018).

A second point relates to the disconnect between DLT narratives – as full of exciting potential to transform the way humanitarians (and others) operate – and the actual evidence of their transformative impact. This is not unique to humanitarian applications of DLTs, as similar critiques appear in relation to their other uses. Most aid organisations have published content aimed at presenting their efforts and framing their role in the DLT space, such as statements about intentions to adopt blockchain or about its potential uses (Das, 2016; Shah, 2017; WFP, 2018). UN agencies (e.g., UNDP (ALTFINLAB, 2017), WFP, UNICEF and UN Women); some NGOs (e.g., World Vision, Save the Children) and others (e.g. International Federation of the Red Cross and Red Crescent Societies (IFRC)) have publicly announced their blockchain ambitions. Yet the proliferation of informal, vague and sometimes contradictory statements about DLTs has contributed to a sense of mistrust (Pisa, 2018; see also Burg et al., 2018) regarding capacity to deliver, and in some cases raises questions about the sector's understanding and mastery of the technology.

Part of this disconnect stems from the lack of existing research about DLTs and their humanitarian applications (see Pisa, 2018). Adopters of DLTs have not embraced Ko and Verity's (2016) recommendations to capitalise on existing research and development, build on current infrastructure, research the humanitarian applications of blockchain technology, and create basic frameworks for understanding and using DLTs. For example, as illustrated below, most pilot projects involving external partners have centred on creating something new.

Only recently have organisations with projects, such as the IFRC Kenya pilot (IFRC, 2018) and the Start Network pilot with Disberse, begun to publish learning and analysis relating to their work. Mercy Corps (2017; 2018) has published two reports on blockchain, the latest of which analyses the technical features and business models (e.g. governance, pricing, environmental considerations) of the leading DLT platforms, concluding that no one specific platform is best for all use cases. Instead, the evaluation of which platform is the optimal one rests on the answers to two questions: one related to its public or private nature, and another related to permissions (Mercy Corps, 2018: 36).

In addition, the UN, through its Special Advisor for UN Engagement and Blockchain Technology at the UN Office for Project Services (UNOPS), has created a platform to streamline information and disclosure about UN-related blockchain efforts.[9] While the platform itself has not yet gained enough institutional traction to translate into a structured knowledge production, sharing and dissemination system, it serves as a clearing house of information about UN initiatives. As part of this effort, UNOPS has launched a series of research partnerships with IOTA[10] (UNOPS, 2018a), MasterCard (UNOPS, 2018b), the Dutch government (UNOPS, 2018c) and the World Identity Network (2018) on topics related to DLTs, including efficient processes, legal frameworks, the fight against human trafficking, and innovative financing. However, these reports examine the uses of blockchain rather than its specific application to the humanitarian sector.

A final issue concerns the knowledge gap that hampers collective discussions about the value and potential of DLTs in reshaping humanitarian action and governance. This is what Lubin et al. (2018: 11–12) call the social construction of blockchain technology. Drawing from the work of sociologists and organisational theorists, they refer to the social construction of technology as 'an iterative social process in which individuals and collectives use a technology, observe its intended and unintended consequences, and then build new technologies'. This is especially problematic for several reasons (see also Cheesman, 2017; LaPointe and Fishbane, 2018). First, the assumptions guiding initial pilot projects can solidify into assumptions about the entire ecosystem. Second, the default option is to allow technology and code to drive the development of

8 Email communication with individual involved in setting up Whiteflag, December 2018.

9 See: https://un-blockchain.org

10 See: www.iota.org

humanitarian applications of DLTs, rather than the needs and uses of those affected. Relying on public–private partnerships without critical perspectives and solid research underpinning humanitarian and social constructions can be dangerous, as 'the problems an enterprise is trying to solve are very different from those faced by vulnerable populations, where access and inclusion usually are far from guaranteed, information asymmetry is rampant, and power dynamics are uneven' (Lubin et al., 2018: 12). These issues are explored in further detail in the sections that follow.

3 Use cases

As indicated above, few advanced use cases of blockchain exist in the humanitarian sector. Instead, much discussion relates to potential and anticipated uses of the technology. The following descriptions of DLT applications for humanitarian purposes are a sample of the projects analysed in the research process and are illustrative of the types of applications and the ways organisations have tested the technology. They illustrate both front-end and back-end applications and represent clear examples of DLTs for humanitarian purposes. These use cases were selected based on their state of implementation – as existing, ongoing, or completed pilots – and the availability of information about the project and its evidence of impact. The list itself is not exhaustive, nor does inclusion constitute an endorsement of the project. While we describe five use cases, we also interviewed individuals working on DLT projects not featured in this report. The summaries derive from interviews for this research as well as public sources, cited below.

3.1 Humanitarian use cases

3.1.1 World Food Programme Building Blocks

Cash-based humanitarian assistance on Ethereum, with four nodes and one controlling entity

The World Food Programme (WFP) is increasingly relying on cash-based transfers (CBT) to address hunger and promote food security. These transfers surpassed $1.4 billion in 2017. WFP's Building Blocks project (WFP, 2018; see also Gerard, 2017; GSMA, 2017: 24–26; Juskalian, 2018) uses blockchain technology to make its voucher-based cash transfers more efficient, transparent and secure, with the aim of improving collaboration across the humanitarian system.

The Building Blocks project began with a small proof of concept in Pakistan, followed by a larger pilot in Jordan. As of September 2018, more than 100,000 Syrian refugees in Jordan have redeemed their WFP-provided assistance through the blockchain-based system. This has generated more than 1.1 million transactions in just over 16 months. To date, over $11 million in entitlements have been processed through the system in hundreds of thousands of transactions. Thanks to DLT, WFP has a full, in-house record of every transaction that occurs at each retailer. This facilitates the reconciliation process and has created a significant reduction in third-party costs. WFP claims savings of approximately $40,000 per month, equivalent to 98% of their previous spending, in reduced financial transaction fees associated with purely digital wallets for beneficiaries. Building Blocks provides additional back-end functions and agility to a system that relies on the biometric ID solutions managed by UNHCR and its technical partners. WFP does not have access to the personally-identifiable information (PII) of recipients, but only to its 'hashed' version – an anonymised record that is used only to validate the transaction at point of sale (POS).

WFP recently formally announced the future attribution of the ownership of a new node to UN Women, another UN agency, which will become the first non-WFP participating entity on the Building Blocks platform. Through the partnership, Syrian refugee women who participate in the UN Women cash for work programme will be able to access their funds directly and their accounts will be kept securely on a DLT network. In the traditional system, women received a monthly entitlement in the form of cash on a set date. Through the new one, UN Women and WFP are aiming to provide female refugees with cashback at WFP-contracted supermarkets or the option to pay for their purchases directly. This allows women to manage accounts themselves, instead of receiving fixed lump sums of funds, and removes the need for setting fixed dates for money distribution and the risks for women in physically carrying money, as well as allowing better tracking and fraud detection. Discussions are underway to further expand the network and include other actors as controlling entities and node owners.

3.1.2 Disberse, Start Network, Dorcas and Trócaire

Ethereum-based financial transaction, with two and three node pilots and one controlling entity

The Start Network[11] comprises 42 national and international NGOs. It works to address systemic challenges in delivering humanitarian assistance. Recognising the parallels between the systemic failure in the financial sector, which triggered new developments such as blockchain technology, and those afflicting the humanitarian system, the Start Network decided to pilot blockchain for humanitarian financing in 2015 (Start Network, 2016).

In 2017 Start partnered with Disberse,[12] a for-profit social enterprise aimed at building a new type of financial institution for the aid industry that uses DLT. Start and Disberse agreed to work together on a series of proof of concept pilots using Disberse infrastructure to increase organisations', donors' and individuals' comfort with the technology. These proof of concept pilots allowed Start to test the technology in a way that matched its humanitarian financing mandate. Disberse received authorisation from the UK Financial Conduct Authority (FCA) as an electronic money institution, making it one of the few UK fintech companies to combine DLT and e-money management.

For the first pilot, Dorcas Aid International, a Start Network member, agreed to test the technology. This first proof of concept use took place in February 2018, and involved a transfer of €10,000 from Dorcas' headquarters in The Netherlands to its country office in Albania. The main purpose of the proof of concept was to test the functionality of the Disberse platform, and to get feedback from Dorcas headquarters and the country office as users. The pilot was successful, with no significant time saving and a small cost saving, as expected.

For the second pilot, Trócaire agreed to test a longer chain with more partners, inviting its local partner Caritas Rwanda to take part. In addition to building on the knowledge gained from the first pilot, this project aimed to measure the feasibility of the blockchain platform by sending two parallel transfers. All parties preferred to start small for the proof of concept; Trócaire Ireland simultaneously transferred €10,000 via Trócaire Rwanda to Caritas Rwanda through the Disberse platform, and €10,000 through its regular banking channel.

The transfer via Disberse incurred no additional charges, although Disberse plans to introduce a transaction fee in the future as part of their business model. The parallel transfer through the banking system incurred at least one additional charge of €35. Trócaire Ireland used this banking channel solely for the purpose of testing the technology, rather than as part of their normal business. Evaluating time efficiency proved to be more complicated. The banking system took six working days, while Disberse's transfer took five. Both processes, however, suffered from delays caused by miscommunication and the fact that testing occurred over a long weekend during a Rwandan national holiday.

To ensure security, both pilots were carried out through participants' web browsers, using Disberse accounts secured by two-factor authentication. Each wallet was identified as a node on the Ethereum blockchain, and all transactions were recorded on the Ethereum testnet. The role of the Start Network as an intermediary was key in bringing together these partners and building trust in the pilots. Overall the Start Network, participating NGOs and Disberse judged the test positively.

3.1.3 Helperbit

Donations and insurance through multi-signature e-wallet using Bitcoin

Helperbit,[13] an Italian start-up, emerged from an increased awareness of inefficiencies in the management of funds for humanitarian emergencies. Helperbit aims to change practices related to emergency response, focusing on humanitarian assistance, the charity sector and the insurance system.

The start-up is developing two solutions running on the Bitcoin public network: a parametric P2P

11 See: https://startnetwork.org

12 See: www.disberse.com

13 See: https://app.helperbit.com

insurance service for pre-disaster phase service and, when an event happens, a P2P donation system that allows donors to control their donations. In a parametric insurance scheme the settlement is not the actual suffered loss, but instead a specific pre-agreed amount that is paid in case of the occurrence of a triggering event (payment of a pre-agreed amount of $60,000 for home destruction, automatically activated by the detection of a grade 6 quake and satellite imagery of the demolished property). In the donation platform people can give directly to NGOs for generic causes or to other entities (such as civil protection, hospitals or municipalities) involved in responding to the emergency.

To enable decentralised, P2P donations for natural hazard-related disasters, Helperbit developed a multisignature Bitcoin wallet. A Bitcoin wallet is a digital wallet using software created to store maths-based currency. Its function is comparable to a bank account, where the bitcoin address corresponds to an International Bank Account Number (IBAN) and the password (i.e. a passphrase consisting of 12 words) is unique and generated when the wallet is created.[14] Helperbit does not require any software download, as the procedure for generating the passphrase takes place on the client's internet browser. The wallet is non-custodial and multisignature, with Helperbit managing only one passphrase out of four, which means it has no decision-making power. This increases the security of the wallet, protecting it from internal mistakes (e.g. loss of a passphrase or incorrect backup) and external attacks, while also providing the possibility of recovery.

Previously registered and verified users can directly benefit from worldwide donations when using this technology. Transactions are made through a Bitcoin blockchain, using either Bitcoin currency or credit and debit card donations. The platform does not charge additional costs for charitable transactions because the business model is based on the premium insurance service. In addition, individuals using the insurance service can subscribe to a blockchain-based policy that will cover collateral damage caused by natural hazards through a fair, transparent and automated system.

In December 2016, after an earthquake struck central Italy, Helperbit began a collaboration with Legambiente, an Italian NGO, which became the first major non-profit organisation in Italy to accept Bitcoin donations. They received more than 10 bitcoins (around $50,000 at the time of the earthquake and $65,562 at the time of writing) from approximately 200 donations. This allowed the completion of the first ever transparency chain for donations certified by blockchain. The start-up launched the donation transparency platform in November 2017 at the Italian parliament. Around 15 non-profit organisations are raising funds using this new approach. The project is currently focused on earthquake response, but the team plans to expand its service to cover all disasters.

3.1.4 Sikka

Digital assets recordkeeping by one controlling entity on Ethereum main net

Sikka (meaning 'coin' in Nepali) is a digital assets transfer platform conceptualised, funded and built by the World Vision International (WVI) Nepal Innovation Lab in Kathmandu. The system was designed to address the challenges facing financially marginalised and in-need communities, to give them better access to finance during times of crisis.

During the design phase of Sikka, around March 2017, the WVI Nepal lab team started working with the WVI Nepal cash programme team. They identified inefficiencies in the traditional modalities and processes of cash transfers, as most actions were still manual and had limited transparency. This generated significant operational costs, logistical complications and security risks.

Sikka was designed to provide three main value propositions: accessibility, as Sikka's services are based on a short message system (SMS) service and can be accessed using a basic feature phone; network resilience, since its reliance on an SMS network makes Sikka's service readily available with reduced downtime, even in case of disaster; and accountability, as each transaction between beneficiaries, vendors and cooperatives within a given programme can be tracked in real-time via tamper-proof, immutable transaction logs.

Sikka allows users to securely access cash or commodities through the digital wallets received upon enrolment. Each wallet is linked to a mobile phone number, which serves as the user ID on the Ethereum blockchain. Sikka does not implement its own identity management system. Through SMS, Sikka tokens become vouchers that can be used to redeem cash, goods and services at local vendors or cooperatives. The tokens represent digital assets

14 Importantly, each address should only be used for a single transaction.

that can be pegged to cash, commodities (e.g. a litre of oil or a bag of rice) or reconstruction materials. The value is valid within a defined ecosystem of beneficiaries, vendors and cooperatives that the implementing agency defines.

The team developed an application running on a server that hosts an Ethereum node. As each user makes a transaction through SMS, the application parses the SMS to trigger a transaction on the blockchain. When the transaction is complete, it sends an SMS to the beneficiary confirming the success of the transaction.

A human controller ensures that the application on the server is running well. Each transaction, as it is parsed by the application, is first validated (an automatic process, completed by the application hosted on the server) to make sure that the phone number to which the user is trying to send tokens is registered in the system, and that the user has the required tokens in his/her wallet to complete the transaction. Otherwise, the application replies to the beneficiary with an SMS indicating the failure of the transaction and the reason for this.

In April 2018, the team conducted a field trial of the system with no technical complications and only minor programmatic challenges, distributing approximately $5,500 to a total of 73 beneficiaries as part of a cash-for-work programme.[15] The post-pilot analysis of the cost showed a reduction in cost per beneficiary from $6.972 to $1.54 – a 78% reduction in the total overhead cost. Despite the small size of the pilot, it is estimated that the savings could be maintained or increased with a larger pool of users. Sikka now has an application programming interface (API) that is ready to be further tested and deployed at a larger scale, having just been validated as low-risk according to World Vision Information Technology's security policies and minimumsecurity baselines.

3.1.5 IFRC – Kenya Red Cross

Audit database on Multichain, with four nodes and three controlling entities

In December 2017, the IFRC was awarded a grant by the Norwegian Red Cross and Innovation Norway to conduct a project to explore how blockchain could add transparency and accountability to open-loop cash transfer programming, and to investigate how the technology could provide people with digital identification. In May 2018, the IFRC, in collaboration with the Kenya Red Cross Society (KRCS), conducted the Blockchain Open Loop Payments Pilot Project in Isiolo County, Kenya, assisting over 2,000 drought-affected households. The objective was to explore the risks and benefits of blockchain technology for humanitarian cash transfer programming.

Red Rose, a technology provider for cash transfers in the humanitarian sector, was asked to implement a data management system integrated with Safaricom M-Pesa mobile money and to construct a private blockchain to record transactions. Red Rose provided Multichain's[16] off-the-shelf solution to cryptographically secure transaction data as part of a digital ledger. Four nodes were connected to this blockchain allowing IFRC, KRCS, and Red Rose to view transactions through a custom user interface. Once Safaricom received the payment request and disbursed cash to the mobile wallets of recipients, the transaction was recorded on the Red Rose platform and the blockchain.

After finalising the beneficiary list, a network of KRCS volunteers visited participating communities to explain the pilot project objectives and questions or complaint mechanisms. The volunteers also delivered an informed consent statement in the local language and asked beneficiaries for permission to use their personal information to verify that they were approved and to satisfy financial regulations to disburse cash. Consent was captured using mobile phones and recorded on the Red Rose platform, but concerns related to the validity of informed consent and the compatibility of DLTs with some terms of the European General Data Protection Regulation (GDPR)[17] remain. IFRC and KRCS are actively exploring the concept of 'self-sovereign' digital identities, which would allow individuals to maintain and control their personal information instead of having humanitarian organisations or third-party providers do so.

15 The full list of transactions can be viewed at: https://etherscan.io/token/0xed9c27d89e146fef4cad24adeca96306af018637

16 See: www.multichain.com

17 In May 2018, the European Commission introduced the GDPR, which governs the use of personal data. All entities operating in the European Union must abide by these new, stronger data protection rules, which provide individuals with more control over their personal data. See https://ec.europa.eu/commission/priorities/justice-and-fundamental-rights/data-protection/2018-reform-eu-data-protection-rules_en

The pilot highlighted some core features of the Red Rose system that contributed to the positive outcomes of the project. Specifically, the data collection tool works offline, even in the context of frequent outages, and the data solution integrates with financial service providers and other third parties through an API. The pilot demonstrated how an integrated solution with blockchain technology can maintain high levels of transparency and protection against fraud, while increasing the quality of programmes. The pilot also provided lessons around beneficiary consent, data privacy, intellectual property (IP) and potential for digital identities (see full pilot report: IFRC, 2018).

3.2 Lessons

This section explores a series of concerns, challenges, and useful practices, drawing from the interviews, use case examples, and related literature. Some of the lessons are specific to DLTs, while others identify systemic challenges to innovation or implementing technologies in the humanitarian system. These insights illustrate a series of risks and opportunities when using DLTs. We have grouped these into lessons emerging at the **project level** (related to specific applications of the technology), the **policy level** (referring to the environment within which DLTs are developed and deployed) and the **system level** (referring to its 'transformative potential' and deployment of DLTs in the humanitarian sphere more generally). These system-level lessons are perhaps the most important *and* the least tangible of the insights that emerge from the research.

Each lesson begins with a short summary of the issue (in italics), followed by a longer discussion of its manifestations and implications. These discussions form the basis for the recommendations that follow in the concluding section of the report.

3.2.1 Project-level lessons

The motivations for adopting a DLT project vary but programmatic and organisational considerations have shaped their use

The programmatic needs of organisations have shaped existing DLT applications and design choices more so than technical specificities or users' needs. At present, the adoption of DLT therefore tends to reflect the needs and perspectives of those adopting the technology rather than the needs of those who are affected by the technology.

Interviewees cited several reasons for exploring or adopting DLTs, often related to a desire to be among the first to test it, as well as the perceived benefits related to transparency, accountability and efficiencies, such as reducing transaction costs. According to one interviewee, the hype is a central motivator:

> *A lot of people are asking what have we done, why haven't we done more, what could we do with blockchain? … We also operate in quite a competitive space, so when other organisations are perceived as being advancing on blockchain then everyone starts running and jumping and trying to say they are doing it better.*

Another reported, 'Quite often people say we should be doing it, even if they aren't sure why we should be doing it. Sometimes it's driven because blockchain is the buzzword'.

When talking about the technology, interviewees tended to focus on organisational or programmatic considerations rather than the transformative potential of the technology or a demand-driven justification for its adoption. For instance, one interviewee shared the following possible uses:

> *The potential use for us could go from supply chain and procurement, giving us a more efficient way to keep track of supplies from pre-procurement to when those supplies do or do not reach human beings, whether that's our partners who carry out a distribution for us or whether we do the distribution ourselves. At the other end of the spectrum are the people we serve, so identity management and then make the link between that and those things that are provided, i.e. plastic sheets, kitchen sets or cash and tokens.*

The adoption of DLT therefore tends to reflect the needs and perspectives of those using the technology rather than the needs of those affected by it. This mirrors a frequent critique of the use of new technologies in the sector – that they are more often a technology in search of a problem than a solution to a perceived problem (see e.g. Campo et al., 2018). Even so, the adoption of DLT has resulted in a series of benefits, as described below.

The deployment of DLT has resulted in process improvements and back-end efficiencies

Implementing organisations have identified a common set of preliminary contributions of this young technology, mostly related to the simplification of bureaucracy, reduced or new roles for intermediaries, automated archive and audit systems, cost reduction, and efficiencies in troubleshooting.

Interviewees reported a range of efficiencies resulting from the use of DLT. The main gains resulted from simplifying bureaucratic processes involving third parties, such as banking institutions. An immutable distributed database with automated archival functions reduces paperwork and removes the need for intermediaries since processes and transactions are automated. This illustrates the potential in connecting parts of a single organisation or across organisations that in the current system too often work in isolation or in parallel. Some projects claim significant cost reductions when adopting DLT, for example the WFP Building Blocks project and the Sikka pilot, as seen in Section 3.1. Because the Sikka pilot used the public Ethereum chain, these savings are real but could change if the project was scaled, as the strictly supervised pilot was small and easier to implement. A larger, scaled project would require additional monitoring and evaluation, as well as accountability mechanisms that are likely to increase the cost of deployment. The Disberse pilot, also implemented on the public Ethereum blockchain, generated more modest time and financial savings.

These differences illustrate the importance of context, as each use case has distinct features and their successes should not be interpreted outside of this context. The WFP project aims to pioneer a DLT platform for the broader community and represents a high-investment, medium-scale, voucher system on a permissioned system in a protected environment. Others are less ambitious. The Sikka pilot was a controlled, small-scale voucher system 'bootstrapped' (attached) onto a public main chain. Its aim was to allow remote voucher assistance without contravening the Nepalese government's prohibition on e-money or mobile cash (because it does not have the capacity to collect taxes on digital financial transactions and payments). The Disberse pilot transferred real money on a main public chain, as part of a larger experiment to provide fintech tools for the aid sector. Nevertheless, it is unfair to suggest that DLTs 'fail' in comparison to traditional services (e.g. transferring cash without blockchain or money using the traditional banking system), even though the financial advantages remain to be proven beyond the testnet or the controlled, small-scale pilot. These pilots show promising capabilities in terms of decreasing existing internal costs due to monitoring and evaluation, accounting, administration fees, and financial accountability, but the full extent of these savings cannot be quantified until these projects reach critical mass and make these costs redundant. Larger and less protected implementations are needed to determine the long-term financial gains compared to the overall investment necessary to develop the platforms and the off-chain integrations that will be required when the system goes to scale.[18]

In addition to reduced transaction costs, interviewees identified positive experiences in using DLT to improve and accelerate the reconciliation of different databases (its auditability), a process now automated in almost real-time, which saved time and resources. For instance, auditors for the IFRC pilot could examine the separate records of the individual systems involved (Red Rose, M-Pesa) and compare them to those on the blockchain. Automation, however, may mean reduced flexibility in cases of actual error. In the same system, if a disbursement occurred by mistake the error had to be corrected on the blockchain as well as on all the interacting systems. Without the blockchain, it would have been possible to cancel the transaction with M-Pesa only (IFRC, 2018). Thus, simply erasing the transaction record was no longer an option.

Interviewees also reported a series of unanticipated efficiencies for beneficiary end users of DLT systems. In one example an interviewee noted how, before adopting the DLT system, users would sometimes make queries about balances or unrecognised transactions, which resulted in lengthy interactions between the organisation and the beneficiary, as well as vendors and banks to understand what happened. Moving to a DLT allowed the organisation to immediately identify and check a specific contested transaction using basic information from the user. In one instance a helpline caller claimed that his account was unduly debited; the team was able to inform him that someone else legitimately used the account an hour before. This saved time and frustration on both sides.

18 We were unable to gather precise figures about the costs of developing and deploying DLT systems. Nevertheless, ballpark figures range from very minimal costs for the development of the DLT system to upwards of $1 million. One cash transfer DLT project budget was approximately $240,000, although only a portion of that supported the development of the technology. A better understanding of the precise costs would help to evaluate the pros and cons of deploying these technologies.

Analysis of the real potential of these pilots would improve enormously if a thorough and public (or at least shareable summary) evaluation of the technical platform, users' needs, and sectoral programming requirements at scale accompanied initial and subsequent DLT deployments. Specific limitations of the current humanitarian system could also factor in the final decision over what platform to use, and under which design. Similarly, the scope of action of the humanitarian endeavour should inform the technical decision. Is the humanitarian project going to use mostly internal resources? Will it receive inputs from external actors? How are these resources going to be delivered to end users? All of these questions form part of the context of deployment, and thus affect the type and scope of possible improvements.

Experience with DLT projects to date points to two additional insights. First, aid organisations have enormous untapped potential in optimising their internal systems. Second, much of the focus surrounding the impact of DLTs in changing the way humanitarians deal with affected populations presents only a partial picture. Agencies that are involved in developing DLTs could also benefit from investing energy in understanding what these technologies can teach them about their own redundancies and inefficiencies.

Humanitarian DLT projects are not end-to-end and require close examination of potential trade-offs

DLTs reputedly function most effectively when they can ensure the traceability of transactions from beginning to end – known as end-to-end – to certify that the totality of the transactions is transparent and immutable, and not just the part captured on-chain. However, gaps remain. At present, humanitarian actors are still required to implement traditional systems to control and evaluate the functioning and impact of DLTs, potentially making DLTs unsustainable.

None of the DLT projects deployed so far has been fully end-to-end in their functioning since their implementation was not fully digital. In all cases, organisations required a work-around or modification, such as redundant paper systems for identity verification and audit purposes, or offline functionality in locations where connectivity is absent. As one interviewee stated with respect to their DLT project, 'There is a piece of paper still behind everything. No one has solved the problem of digital registration where there is no electricity. You can't always go to a wi-fi hotspot to register people'.

All projects identified in the research made use of pre-existing non-DLT systems, including financial systems, banking services, paper-based or analogue recording of data, or voucher systems/networks of approved actors. For example, financial and banking services are still needed on both sides of DLTs, whereas a fully digital DLT would use cryptocurrencies at both ends of the transactions. For all the use cases profiled here, back-end financial transactions, such as the use of the Disberse platform, require the use of fiat currency, while other cash transactions often require a separate paper trail. As one interviewee confirmed:

> *Paper agreements are still in place between [our organisation] and the vendors who then consent to using this software for accountability/auditing purposes. It's really just a digital asset system. It manages the flow and movement of digital assets and the information connected to it, so it is similar to an accrual accounting system.*

With cash transfers, beneficiaries need to convert tokens into their local fiat currency, as end-to-end distributed networks are not yet (and might never be) proven to be fully reliable.

In other instances, humanitarian agencies lack reliable or accessible digital identity systems (e.g. biometric or other electronic IDs). Most solutions fall into one of two categories: one requiring direct registration by the project, or a second that assumes various degrees of risk that correspond to the quality of either the off-chain proof of identity or its third-party certification (e.g. UNHCR biometric IDs or M-Pesa ID). The latter is unlikely in humanitarian crises where no third-party (government, UN agency, or private sector) digital IDs exist, or in conflict settings where government IDs might disenfranchise particular groups or other third-party IDs may be absent or untrustworthy. The former option also has limitations, in that analogue solutions must find ways of avoiding errors, redundancy or abuses that affect traditional paper-based registration processes. Both options require all parties using the DLT system to trust the registration process of others, and face similar issues related to the accuracy of the information in the digital or paper-based register. In addition, they expose a fundamental problem of PII custody: who stores it, and where? Who protects it? Can those who registered the person track them across all services and activities registered on the chain, while

the others are blind? These issues must be addressed as part of any DLT project.

The lack of mobile or broadband connectivity in many emergency contexts likewise compromises the implementation of end-to-end DLT projects. Interviewees recognised that DLTs will not be a viable solution for 'last mile' delivery in extreme humanitarian crises for years to come, due to cost and weak infrastructure (see also Zambrano, 2017; Rauchs et al., 2018). Hybrid models based on the integration of DLTs with the internet of things (IoT)[19] and mobile solutions have shown promise. Nevertheless, offline interactions remain the weakest link in the whole process, as raised by numerous interviewees. This is particularly acute when IoT is involved, since these systems often integrate both online and offline devices and are among the most vulnerable to cyberattacks. If the last mile is less secure than the remainder of the chain, the entire system is compromised; avoiding problems at this stage this could require the deployment of additional resources for in-person and digital monitoring, evaluation and audit systems, compromising the long-term sustainability of the project. As a Mercy Corps report highlights, however, the ability to deploy hybrid or last-mile solutions depends on decisions made long before the implementation phase, such as the choice of platform or whether the DLT is public or private, which can influence the resilience of the underlying network. In particular,

> *a public blockchain will have more active nodes and is likely to include greater diversity in the operators of those nodes. More nodes and more diversity create a network that is more resilient to downtime and more resistant to fraud (Mercy Corps, 2018: 7).*

In other words, a greater number of nodes increases the ability of the entire system to maintain the DLT characteristic qualities of transparency and immutability, even when parts of the system are offline. For the reasons presented above, reduced connectivity naturally pushes towards a reduction in the number of nodes, or a higher concentration of nodes in the hands of fewer controlling entities.

Despite the importance of choosing the most appropriate platform and technical architecture for the scope and challenges ahead, humanitarian actors do not appear to have a specific process for assessing options and selecting the most appropriate solution. One thing is evident, regardless of the amount of technical analysis supporting a DLT project: until the self-sovereign ID and 'last mile' challenges have been solved, most of the advantages of implementing DLT in comparison to traditional database systems in humanitarian crises will apply primarily to back-end functions.

Data protection and privacy must be incorporated at all stages from design to implementation, and at the project, institutional and systems levels

A series of factors, including the introduction of GDPR and data breaches within and outside the humanitarian system (Parker, 2017), have combined to raise awareness about the importance of integrating data protection and privacy into DLT projects. Most agencies have adopted a cautious approach to data, choosing to limit personal data stored on DLTs.

At present, very few teams seem to have a clear and decisive roadmap surrounding data protection and privacy concerns, or corresponding legal issues. This is a fast-evolving and complicated sphere, encompassing everything from the protection of PII (ICRC, 2018a) to the risks related to aggregated group-level data (Taylor et al., 2017) and the challenges of metadata (ICRC and Privacy International, 2018). When asked about data protection and privacy, interviewees typically mentioned GDPR regulations and existing organisational policies governing PII. In several instances – usually in relation to small or one-off pilots – interviewees did not have clear answers to questions about data protection.

By default, most implementing organisations have decided to adopt a cautious approach by not storing PII on-chain in their pilot projects or using third-party verification for PII data. In addition, many decided to maintain a low profile, trying to keep the transition to DLT invisible to the end user. While a logical choice for pilot projects, this approach has disadvantages, most notably that, when the time comes to add PII or to bring recipients in direct contact with DLTs, the systems themselves will be at an advanced stage that precludes participatory

19 As noted in the glossary, IoT systems allow traditionally non-connected devices to communicate among each other, even in the absence of connectivity. A hybrid model would integrate a DLT online chain, with inputs from offline IoT devices connected to each other and to a gateway ensuring communication with the DLT system. No examples exist so far in the aid sector.

approaches and co-creation. Recipients of aid will therefore remain relegated to roles as passive recipients of technology designed for them instead of with them.

Additional concerns relate to the security of DLT as well as the accuracy of data initially put onto the chain. Verhulst (2018) refers to this as 'securing first block accuracy', and points out that 'while blockchain's attributes of immutability and integrity ensure accuracy for on-chain information, the first block in the chain remains an important single point of failure'. As one interviewee pointed out in relation to land registries, 'incorrect information at the beginning could disenfranchise people down the line'. Avoiding this outcome requires a high degree of confidence in the information itself and trust in the partners involved, as well as the ability to review and validate 'first block' data.

At an institutional level, the absence of digital data protection strategies tailored to the specific risks brought about by DLTs raises serious concerns, of which most teams are aware. While most projects verified data protection compliance with their legal and protection department, most interviewees reported not having a protection specialist, or a person specifically accountable for protection issues among its core project members at the country leadership level. As indicated above, the most common solution adopted so far – instead of developing dedicated frameworks and policies – is to avoid putting any PII on the chain, which limits the type and kind of assets that can be transferred through the system. The reason for this approach seems to be uncertainty surrounding the future development of this technology, and conveys a narrow conception of protection, one limited to PII mismanagement. While this is crucial, it is not broad enough to deal with the range of potential privacy, legal, and jurisdictional issues.

The use cases indicate these issues need to be tackled at a project, institutional and system level. As a starting point, the ICRC organised a broad-based reflection on digital risks for people affected by conflict (ICRC, 2018b). For DLTs, agreement is needed regarding common core minimum digital data protection standards that should guide future development of distributed technologies, beginning with the assumption that the DLT could, at any moment, contain PII or other sensitive information.

3.2.2 Policy-level lessons

Internal policies, processes, and people pose additional hurdles for humanitarian innovation, particularly DLT projects

As with many new technologies, the challenges of implementation relate not just to the technology itself but to internal processes and to a lack of support or understanding from others in the organisation. The research findings suggest that management, procurement, legal and financial policies are not fully supportive of innovative strategies and emerging technologies. This is especially true with respect to understandings of the legal implications of DLTs or their transformative implications, beyond the replacement of some traditional aid functions.

Multiple interviewees cited internal challenges as a significant barrier to adopting DLTs, particularly in terms of explanations about DLTs and securing approval for blockchain pilots or initiatives. Lack of knowledge about blockchain exists throughout organisations and, as one interviewee observed, 'there is often a perception of risk where risk may not exist or may not exceed the existing risks [related to non-DLT databases or technologies] because there is a lack of knowledge of what the technology does'. The interviewee continued:

> *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 organisation], I have to figure out how to be an expert in explaining blockchain to the country-level staff.*

A second interviewee reported that 'pilots couldn't easily get to scale because of internal blockages' and that those involved spend significant amounts of time 'normalising' DLTs and bringing various branches of the organisation together to gain support and buy-in and streamline the process. Another interviewee noted difficulties in getting clearance from management for the use of tokens for financial transactions, often because of a 'dearth of knowledge management' that results in cultural, knowledge and learning gaps.

As with many other technologies, issues related to people and work processes pose bigger obstacles to implementation than the technology itself. As one interviewee stated: 'The devil's in the details … People need to focus less on the technology and more to the people. I've never met a technical problem that wasn't a people problem in the first place'. Another reported, 'part of the process of testing blockchain has shown us it's less about the technology and more about the rules, processes, procedures'.

Similar obstacles plague the development of public–private partnerships (PPP) for DLTs. Evidence from the research suggests that traditional relationships between actors involved in humanitarian partnerships, and especially between humanitarian actors and private companies, are inadequate to create a conducive environment for the creation of DLTs. Compared to client–vendor relationships, PPPs have encountered problems related to disagreements on IP or project governance. Some issues are already well known, such as the slowness of partnership processes, but more specific complexities arise when an emerging technology comes into play.

Interviewees repeatedly cited IP issues as problematic in developing consensus and interoperable systems. The interests of a private company developing a proprietary technology often clash with the interests of organisations that wish to build public goods or interoperable systems, since the latter requires open code and/or open source technology. Moreover, without a solid regulatory framework, agreements on digital rights for distributed assets become too complex for most humanitarian organisations to navigate as many do not possess the required specialised knowledge or technical expertise. One interviewee linked this to the hype surrounding DLT: 'It is cynical but reflects a reality that we don't have the expertise in the organisation to understand DLTs'. Where it does exist, knowledge is generally confined to a few individuals, which hampers organisations' ability to fully understand the implications of the development of the technology and to advocate for alternatives, such as shared development or open code that facilitate the development of interoperable systems. Interviewees also confirmed that competition between private providers to become partners in humanitarian initiatives functions to 'push' the sector towards dispersed, uncoordinated and incompatible systems, primarily because actors are not eager to share technical specifications or include interoperability in the product tender requirements.

These disconnects have resulted in delays and additional costs. Some interviewees suggested that in practice pilots result in a hybrid model that is neither a PPP nor a commercial relationship, because relevant internal offices lack technical expertise, such as a thorough understanding of the technical development of distributed systems, or the capability to run tenders for emerging technologies through public offices. As happens in many innovation contexts, piloting DLTs is easier for smaller organisations than larger ones. Smaller organisations, however, often have limited resources, thus undermining project longevity and the chances of scaling. Donors could minimise this issue by providing funding on a multi-year basis with potential for future support for scaling. Larger organisations need more transparent, updated and flexible procurement processes, as well as a more proactive approach to contributing to regulatory frameworks that are flexible and reliable.

The design and development of humanitarian DLTs occurs in siloes, behind closed doors, which fundamentally limits interoperability

Despite common claims that DLTs will fix problems and streamline humanitarian aid across actors, most humanitarian DLT projects operate in silos and in relative secrecy. This minimises options for public scrutiny over code or strategy and limits the possibilities for developing interoperable systems across organisations and across sector-specific uses. By contrast, outside of the aid sector, many private and public DLT initiatives have consciously adopted an open source approach and allowed the public – including those using DLT for humanitarian purposes – to study, edit, copy and critique their code and architecture.

At present, most humanitarian-focused initiatives do not publicly release their software and reveal no specific plans to do so. This hinders collaboration and the cross-pollination of ideas and impedes the creation of broad developer communities around DLT projects, particularly nascent tech communities in the countries where many of these technologies will be deployed. Most importantly, it drives competition in the sector rather than promoting the development of DLTs as a public good. To use and create open source technology wherever possible is a

key tenet of the Principles of Digital Development[20] and reflects design principles that call for DLT initiatives to 'synchronise with existing initiatives' and adopt 'interoperability and open standards' (Verhulst, 2018).

Considering the significant investment required to start up a reliable, efficient and secure DLT platform, another option is to use DLTs as a fabric that knits together familiar and trusted systems in a way that suits project needs and those of the communities being served. The IFRC project profiled above chose this route, finding it easier to draw on multiple customised yet easy-to-integrate technology platforms that met the needs of the project and had been separately used and tested at scale, rather than developing a new comprehensive system from scratch that is difficult and costly to change. The result is a more responsive and transparent system for their cash programme. When initially trying to build from zero with new tools and partners, the team encountered significant obstacles in reaching an agreement with service providers. This almost derailed the project because of increasing costs and delays. In contrast, the integrated solution was implemented in around a month.

A key justification for the decision to maintain non-public DLT development concerns the difficulty of being trailblazers in this domain, as those who make the first move enter uncharted territory and take on greater risks. This closed approach, however, comes with costs, including losing the opportunity to build interoperability into new systems and pilots. Moreover, institutions usually have limited knowledge on which to build, and available technical knowledge is not easily shared. Finally, designing a robust and interoperable DLT system outside of existing networks entails a substantial investment, and typically requires that one or a few trusted organisations lead the DLT design and development, including the code, data, and system architectures, on behalf of a larger whole. Yet if such a level of trust exists, does the need for a complex, 'trustless' technology still exist?[21] Paradoxically, adopting a 'build it and they will come' approach may not work either, precisely because of competition and a lack of trust in the humanitarian sector more broadly. This suggests the sector is unlikely to be able to designate a single actor or group of actors to develop a DLT that could serve the needs of multiple agencies. The alternative, then, is to develop platforms to which agencies can contribute and from which they can learn. This necessitates open code and iterative development, which would bring greater potential benefits than a project aiming to develop a single, comprehensive approach.

The lessons of the past related to other innovations in the humanitarian and development sectors are instructive here, illustrating potential obstacles and unintended consequences of multiple pilots, the challenges of scaling (McClure et al., 2018), and the development of technologies in organisational or sector-specific silos. For example, a plague of 'pilotitis' characterised the development of mobile health projects in Uganda. At one point this included upwards of 500 pilot projects, all supported by various donors wanting to scale the projects. Yet little concrete evidence of their actual impact existed (Tomlinson et al., 2013), eventually leading the Ugandan government to enforce a moratorium on new pilot mobile health projects in the country. While not in a similar state at present, persistent silos in the development of DLT risk creating a multiplicity of platforms and models with limited interoperability and minimal exchange of lessons learned and best practices. It is in the interest of those financing humanitarian applications of DLTs, including the major humanitarian donors, to avoid duplicating or overlapping work in this area. This is particularly ironic and illogical in building a technology designed to streamline processes and increase efficiencies.

The absence of robust regulatory frameworks in many contexts is both an opportunity and a risk

DLTs have the potential to improve service delivery in low- and middle-income settings, provided that solid and applicable regulatory frameworks are in place. At the international level, multiple legal frameworks can apply, requiring DLT developers to involve legal counsel from the outset.

Those deploying DLTs have, to date, done so in environments with a relatively healthy infrastructure (mobile and broadband connectivity, banking and

20 See https://digitalprinciples.org for more. Principle 6 calls organisations to 'use open standards, open data, open source, and open innovation'. This principle, however, is much debated and reflects a common tension between private development of a technology or resource (e.g., medicine or DLT) and its public good uses (e.g., affordable medicines for diseases that afflict those who live primarily in non-OECD countries; DLT for social impact or humanitarian uses). Recognising this, the principle affirms that 'what being "open" means for your initiative will depend on practical and technical constraints, security and privacy concerns, and the dynamics of the people and networks in your space'.

21 Lehdonvirta (2016) refers to this as the blockchain governance paradox.

physical infrastructure), such as Jordan, Kenya, Nepal, Albania, and Rwanda, and not in contexts with high levels of violence or insecurity. Thus, humanitarian DLTs seem to have particular added value in low- and middle-income countries where local systems and infrastructure are developed enough to support this kind of technology, and the regulatory system is sufficiently flexible to facilitate humanitarian innovation. In Nepal, for example, the Sikka team leveraged the capacity of DLTs to mobilise digital assets without resorting to cryptocurrencies or mobile money, and found a legal, digital way to deliver aid in a context where the government discouraged any form of electronic cash aid delivery.

Implementing DLT in a regulatory vacuum may facilitate short-term wins but could equally result in unintended consequences or harm. Eliminating the ability of intermediaries (e.g., governments or banks) to claim transaction fees, for example, alters existing power balances and may trigger prohibitive regulations even as it temporarily decreases financial costs. This could involve liability for the staff involved or the organisation itself. In Nepal, the Sikka team ensured the system conformed to government-imposed regulations and also with their spirit, and therefore that the authorities received fees and taxes from local transactions, which they needed to continue to provide basic services.

At the international level, especially when money transfers or cryptocurrencies are involved, different legal frameworks can apply simultaneously based on hard-to-predict factors such as the country of registration of the parties involved, the location of servers and data storage facilities, or even the nationality of users. In other cases, regulatory frameworks can facilitate testing combined with safeguards. For example, Disberse is licenced by the FCA, which allowed them to apply to the FCA 'regulatory sandbox' (FCA, 2017). The 'regulatory sandbox' permits real-time testing of new products, services, business models and delivery mechanisms while offering simultaneous protections to consumers. Disberse met the eligibility criteria and was accepted into a testing phase that involves short-term and small-scale testing, with agreed parameters and consumer safeguards. Although this represents an improvement in comparison to DLT pilots that operate outside of public oversight, it is unclear how such systems also consider the rights and interests of foreign customers on the other side of the chain, beyond FCA jurisdiction.

Existing use cases suggest that humanitarian actors deploying DLTs need to proactively analyse and clarify, at the outset, which regulatory frameworks are applicable at various levels and with relevant authorities. This type of analysis requires specialised 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. At present, this type of legal advice does not exist and represents a significant knowledge gap. Overall, the humanitarian sector should advocate for clearer, more transparent regulations to allow the safe and rapid roll out of DLT projects.

3.2.3 System-level lessons

At present, process improvements represent the primary value of DLTs, not transparency and trust, which are inherently double-edged for the humanitarian sector

Although transparency and trust are held up as two of the most significant benefits of DLTs, the research suggests that neither represents the core advantages of current deployments. Instead, interviewees reported other potential advantages related to process improvements (improved efficiency, lighter bureaucracy, financial savings, as described above). In fact, DLTs' trust and transparency features are inherently double-edged for the humanitarian sector.

In public debates about the potential of DLTs, those in favour often cite the promise of renewed trust that could accrue to the humanitarian sector, through improved efficiency, increased transparency and more effective collaboration. These are not yet apparent. With the exception of HelperBit and – to a certain extent – Sikka,[22] the use cases analysed for this report currently do not allow public access to or visibility of the transaction happening on the platform, despite the reported absence of sensitive data on-chain.

22 In the case of Sikka, transactions are publicly traceable online (see, for example: https://etherscan.io/address/0xed9c27d89e146fef4cad24adeca96306af018637), but it is impossible for the average reader to understand to what these transactions refer.

Similarly, no project reported setting up automated control systems to allow for external accountability of transactions.[23] Finally, most projects did not extend beyond their existing 'family' of organisations: the IFRC project collaborated primarily with the Kenya Red Cross, even though it integrated external platforms such as RedRose; WFP's Building Blocks, at the time of writing, involved collaborations only within the UN; the Start Network pilot involved a third-party financial services company (Disberse) and transactions with (and not between) its members. Interviews for this research instead suggest that many involved in DLT projects see the correlation between DLTs and improved trust as an indirect and secondary effect in comparison to other factors.

The core DLT features of trust and transparency offer mixed reviews. A common trend emerging from interviews is an ambivalence regarding the concept of transparency, often hailed as a core feature of DLTs. So far, no system has been designed to allow end users to trace their own transactions or verify that they received the correct funding from donors – a feature particularly relevant for P2P systems. While DLTs are often praised for introducing efficiencies and reducing costs, a larger disruption for the humanitarian sector may lie in the increased transparency that would result from implementation of DLT-enabled monitoring and reporting systems, eliminating the fungibility of donations. This could increase 'dramatically the expectations of transparency from donors and supporting institutions and [put] new pressures on NGOs to expose their operations to an unprecedented degree' (Mercy Corps, 2017: 4). A DLT solution to the issue of tracking restricted funds, for example, could increase transparency and thus the confidence of individual or institutional donors. This could be particularly beneficial in places that have adopted remote management approaches. Yet, as one interviewee noted with regard to DLTs for supply chains:

> *You really need to trust what a supplier or vendor in the programme is entering is actually true. If they say they paid $50, how do you know they didn't pay $30 and put in $50? You still need a human element. Immutability is great, but it only works if people are putting in what is accurate.*

In short, the accuracy of the first block remains a significant challenge to building confidence and minimising corruption more generally.

Although early results of DLT evaluations suggest that adopting this technology will increase capacity to monitor the flow of humanitarian resources, full immutability and transparency may not always yield positive results. For example, in some humanitarian contexts diversion and manipulation tend to be an open secret – widely (if usually privately) acknowledged but without clear evidence of scale (e.g. Harvey, 2015). A DLT system that forces full transparency on flows of humanitarian resources would provide clearer evidence of the scale of diversion, which may generate unfavourable publicity and undermine trust, regardless of the response by the organisation. Although DLTs allow better scrutiny of transaction history and processes, scandals that have rocked the aid sector, such as the recent one related to sexual exploitation and abuse, have shown that an unwillingness to act can exacerbate the problem more than a lack of awareness of what is happening (Ratcliffe, 2018). In short, DLT systems offer limited guarantees that improvements will result in increased trust in a digital era where errors and scandals go viral more quickly than eventual fixes. Thus, the ability to make transactions completely transparent, accountable and immutable could create ripple effects with unclear and unintended consequences, eventually undermining rather than increasing trust.

A leading narrative maintains that better accountability and increased transparency could restore trust in the humanitarian sector. While, as highlighted by some interviewees, DLTs could contribute to improving trust, it appears that the dominant approach is to adopt the technology, while leaving the larger, systemic questions of the role of trust for future reflection, rather than initially incorporating control systems into the project. At present, this limits the potential of current projects to reduce corruption and improve accountability over existing systems.

23 Several of the projects involved external accountability (e.g., the IFRC project's auditability – see IFRC, 2018) but this was not automated.

Lack of meaningful consent and engagement in DLT project design risks undermining accountability to recipients and facilitating surveillance-type systems

Most DLT projects run on private, permissioned platforms and end users and local communities are mostly unaware of the back-end DLT system. This raises fundamental questions about the nature of meaningful consent (Campo et al., 2017) and humanitarian experimentation (Sandvik et al., 2017). This path 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.

For the most part, local authorities, communities and beneficiaries are currently excluded from the design phase and setup of DLT projects as well as their evaluation, often because their PII are not included on it or under the pretext that they do not understand or directly engage with the technology. This both strengthens and mirrors the general trend in the sector, where accountability in the use of technology is still oriented towards donors and not the recipients of assistance, as more than one interviewee pointed out. This lack of involvement counters ethical guidelines and obligations for the use of emerging technologies in the humanitarian sector, such as the Signal Code for information and communication technologies for humanitarian activities, that advocate for technologies that *begin* with the needs of affected communities (Campo et al., 2018).

Even if sensitive information is not stored on the DLT system, storing and sharing more data creates additional risks of disclosing sensitive information about recipients of aid, thus increasing their vulnerability. For example, in September 2017, concerns surfaced about the Bangladeshi government's plans to create a 'merged ID' that would combine citizens' biometric, financial and communications data (Rahman, 2017). At that time, some local organisations had started exploring a DLT solution to identify and serve the needs of local Rohingya asylum-seekers and refugees. Because aid agencies are required to comply with national laws, any data recorded on a DLT platform could be subject to automatic data-sharing with government authorities. If these sets of records were to be combined, they would create an indelible, uneditable, untamperable set of records of highly vulnerable Rohingya asylum-seekers, ready for cross-referencing with other datasets. As Hosein and Nyst (2013: 2) noted, 'as development and humanitarian donors and agencies rush to adopt new technologies that facilitate surveillance, they may be creating and supporting systems that pose serious threats to individuals' human rights'.

These issues raise questions about meaningful, informed consent – how and to what extent do aid recipients understand DLTs and their implications when they receive assistance? Researchers have raised similar concerns about the use of biometrics – to access assistance, recipients must comply (e.g., Jakobsen, 2015). Although this may appear to be a far-fetched problem in a nascent technology, some interviewees pointed out that recent events involving misuse or abuse of data access by data controllers and third parties should not be ignored (see e.g. Parker, 2017). Most experts agree that data protection needs to be considered not only in the realm of privacy, empowerment and dignity, but also in terms of potential physical impact or harm (ICRC and Brussels Privacy Hub, 2017; ICRC, 2018a).

While it is difficult to imagine that end users are fully aware of DLT's technical specificities, to avoid past errors it is imperative to develop new ways to involve recipients of DLT-based aid in planning solutions that are most appropriate to their needs. Learning from and building on others' efforts in this regard is crucial. The IFRC case discussed above provides one such example. Before the IFRC and the Kenyan Red Cross Society initiated the design phase of their DLT project, the team engaged with beneficiaries and authorities at all levels to request and obtain the necessary authorisations, and to inform all stakeholders of the modalities of the new initiative. Their informed consent process represents a unique effort, since blockchain was the term used in the consent text. It remains unclear, however, to what extent the communities involved were fully aware of the nature of this technology and its implications. IFRC's evaluation acknowledges the problematic nature of conflating consent and access to services:

> *During a survey, four respondents expressed concern over the Pilot's use of their personal information, but they still opted to give their consent. In interviews beneficiaries explained that they trusted KRCS and that this trust extended to its partners. However, had beneficiaries not consented they would have not received assistance (IFRC, 2018: 7).*

This illustrates the well-known conundrum for humanitarian service providers that find themselves in the difficult position of either barring non-consenting individuals from accessing services or

setting up parallel alternative systems for them, thus undermining the efficiency and added value of adopting a DLT-based solution.

Support for digital awareness and literacy and building national-level tech capacity could facilitate local ownership and contribute to a shift from analogue to digital in these same countries. More broadly, one lesson emerging from DLTs, which applies equally to most emerging technologies, suggests that data protection issues are not confined to the data produced or stored, but also relate to the orientation of the technology itself. Because many organisations are testing the technology and may not be fully aware of its original libertarian orientation, as one interviewee pointed out, organisations are essentially 'designing in a blind state, as code is driving them in unpredictable ways, rather than following a precise roadmap'. A broader understanding of the technology enables more peer input and risk mitigation (LaPointe and Fishbane, 2017). User-led design has been widely identified as a significant factor in reducing protection risks in the implementation of innovative projects. Involving vulnerable individuals and their communities in defining the solution is not only an issue of agency and dignity, but also a matter of protection as well as a key pillar of a 'do no harm' philosophy (e.g. Anderson, 1999; ICRC, 2018a).

In a DLT system where trust in the software replaces trust among parties, humanitarians need to transport their principles to the digital product

Invisible biases and assumptions underpin automated systems, including DLTs and blockchain. These biases may undermine their potential for positive impact and eventually generate unintended consequences for affected populations. Aid actors should adopt an inclusive approach by default, be transparent and clear in the programming and design of systems, and aim to apply humanitarian principles to digital products and programmes.

In its original conception, blockchain's value was rooted in a shared trust in its underlying code, despite trust being absent among those developing or using the technology. This works well with cryptocurrencies, which are not fiat currencies backed by a government, because their value is tied to demand. In making an exchange, individuals trust the transparency and immutability of the code, and therefore of the transaction. As one interviewee put it, 'In places where you have no recourse to law, no trust and everyone has the competence to read a ledger – that's where blockchain works. But they still don't trust each other'. Similarly, a variety of sources, so far primarily focused on artificial intelligence (e.g. Chapman and Brustein, 2018) and big data (O'Neill, 2016), highlight the dangers of setting up automated digital processes without considering the influence of subtle or hidden biases in the programming phase and system architecture design.

Crucially, these technologies are not neutral and we must not pretend they are. Like the economic models they replace, DLTs do not consider vulnerabilities, do not try and mitigate harm, and do not adhere to humanitarian principles. They are proposed as alternatives to traditional systems and models yet, by default, they reproduce visions and ideals often linked with specific ideological and cultural perspectives.

As the use of technologies in the humanitarian sector continues to grow, awareness of these biases and their embeddedness is crucial. Remote and other technologies are gaining ground in the sector, but stand in tension with the traditional core humanitarian narrative – alleviating suffering by providing assistance and protection through presence. While these technologies can play an important role in facilitating assistance, they carry risks that emerge from their underlying philosophies (libertarian, trustless world vs humanitarian principles). Humanitarians must be fully aware of how these understandings are built into digital systems, since underestimating such biases could undermine core humanitarian principles in subtle and almost undetectable ways. For example, in emerging technologies aiming for extreme automation, this is known as the 'black box' problem: the system generating outputs and taking decisions is so complex that it is almost impossible to discern the logical process that led to the final result (Bloomberg, 2018). In contrast, for humanitarians, clear and direct links between need, assessment, and assistance are crucial in demonstrating an appropriate and principled response. Moreover, the underlying notion of trust in the humanitarian sector is typically based on shared humanitarian principles, collaborations over time and across emergencies, relationships between individuals working for an organisation, or in the nature of the giver–receiver transaction (which arguably is not trust at all (Mauss, 2011)). This is fundamentally different from the principle of trust that characterises DLTs.

The goal is not to prohibit the use of DLTs because of these biases, but instead to take an informed decision to use them and to mitigate their risks. Adopting a transparent and open approach to the code and development of DLT systems and platforms is a first step, as is sharing lessons and insights about their design and deployment. By designing major DLT projects behind closed doors, without allowing a broader set of inputs and the free cross-pollination of ideas, forms of confirmation bias could become embedded in a platform's design. These could be further strengthened by moving roles and processes in a direction that controlling entities believe will bring the most benefit to their reputation. While it is impossible to avoid all bias, ensuring the broadest possible diversity and inclusion in the design and programming phase could improve the chances for positive impact and reduce the risk of injecting bias into the system. Finally, once the DLT system is up and running, human checks and balances are needed to avoid automation bias (Skitka et al., 2000): that is, a failure to respond to system irregularities or events because automated devices fail to detect them, or a failure to impede an automated directive despite contradictory information from other reliable sources.

At present, the distributed humanitarian system replicates the governance and power dimensions of the systemic status quo

DLT projects in the humanitarian sector generally adopt a reformative instead of a transformative approach. Accordingly, the project processes investigated reproduce many of the underlying power dynamics, hierarchical structures, financial flows and even deployment strategies used for traditional pilots. This also applies to those cases with an opening for increased cooperation and that envision external actors as peers, node owners or managers of future iterations. Moreover, this mostly includes traditional actors rather than including affected individuals and communities.

DLTs are hailed as a game changer, but to truly achieve their transformative potential their implementation requires deep structural change that extends beyond present governance approaches. The DLT data governance issues are threefold:

1. Internal, with reshaping needed to automate existing systems and modify roles and processes within agencies themselves.
2. Endogenous, with agreement among actors in the humanitarian system on a dynamic governed by trust in open code.
3. Exogenous, regarding users themselves, their communities, local organisations, and authorities as peers and equals in the system.

First, with a transition to a meaningful and far-reaching DLT system, it is likely agencies could streamline some programmatic roles, as well as some managerial, financial and accountability positions. For example, a DLT project that automates and verifies cash transfers may reduce the need for internal financial auditors, just as it decreases internal costs related to monitoring and evaluation, accounting, and administrative fees. In the cases of Disberse and WFP discussed above, scaling DLT systems would result in a reduction of most of the financial, accounting, administrative, and monitoring/evaluation roles at all stages and layers of cash transfers to one or a few points of control, potentially for the entire sector. In a 2014 report on internal audit for charities and not-for-profit organisations, Deloitte noted 'how the demand for services from the Charities and Non-for-Profit sector has continued to rise despite the funding crisis, which when combined with reductions in funding can really stretch organisations and adversely impact on their internal control framework' (Deloitte, 2014: 1). The adoption of DLTs could represent an opportunity to maintain the quality of the internal control system, while simultaneously consolidating financial resources towards core operational and sustainability activities.

In adopting DLT, humanitarians appear to accept a gradual – but not necessarily a radical – transformation of their role. As one interviewee put it, the potential of DLTs opens the door for conversations

> *about what it means to be an NGO in a world where blockchain becomes more common. Perhaps our role then becomes the auditor, the trusted entity that certifies and audits whether the data being put on the chain is trustworthy, and then the role around brokering, so we might have some specialisation for using blockchain for social impact.*

This scenario, however, maintains humanitarians' status as intermediary, which is redundant in a DLT system that automatically verifies transactions. Nevertheless, it shows a growing awareness about the need to rethink the nature of humanitarian agencies in

the context of DLTs. As Mercy Corps observed in its blockchain report:

> *[t]o the extent that international NGOs function as guarantors of trust – trust that the funds donated will be used for an appropriate purpose, trust that the aid has been given to the right beneficiaries, trust that the development work that was contracted for was done on time and as specified – then NGOs too are poised for disruption (Mercy Corps, 2017: 3).*

At present this is still far off. Some of the power and authority that aid agencies have traditionally embodied will need to be embedded in the code itself, such as verifying individual identities when they make transactions. New functions will emerge from the permissioned nature of these platforms. Permissions require designating power to validate transactions and control various nodes to a few key roles. The power inherent in these roles raises concerns about accountability mechanisms and at what level validation will occur (e.g. project field staff, at headquarters, or elsewhere). Discussions on these points have either not started or are only in the early stages, mostly due to the newness of these pilots. Decisions related to governance design, however, affect the system architecture of the DLT system and, as such, need to be addressed at the beginning of the development process.

Second, a similar discourse applies to the development of a common, shared humanitarian DLT platform that effectively harmonises different processes. The development of such tools has already started, albeit without visioning or planning for what a distributed humanitarian governance system could or should look like at global, regional, or local level.[24] Problems related to information-sharing restrictions, technology requirements and functions and the asymmetrical capacity among international and national NGOs and local communities in producing and uploading information and monitoring will not disappear. Instead, platforms will accentuate these issues unless they are considered from the beginning – a difficult endeavour indeed at this early stage of the technology's development. Other questions remain about system governance, particularly for a distributed humanitarian system encompassing all or several major humanitarian actors, or how funds would travel from donor to implementing body when several functions are shared across organisations.

It is also unclear whether such a system would run in parallel to existing structures, or if the end goal is to replace and automate the entire humanitarian financing and administrative system. At present, most humanitarian DLT applications (outside of financial transactions, such as the Start Network/ Disberse partnership) are private, with one or a few nodes. WFP's Building Blocks platform, for example, is currently composed of four nodes managed by a single entity, and is soon to include others as new organisations join the platform.

As WFP has acknowledged, the initial blockchain application could function as a traditional database; achieving the full benefits of the new technology requires multiple organisations and nodes (GSMA, 2017: 27). This requires trust between organisations, especially as governance systems in a multi-node system need to be negotiated concurrent to their implementation. This includes who validates the data, how data is shared and with whom, who stores data and where, and who can modify the platform and how. As several interviewees acknowledged, existing competition and lack of trust between agencies could undermine efforts to get multiple organisations to sign on to a system built by one agency. As one interviewee stated, 'If one organisation owns all of the IP, then other organisations may not want to get involved because it would all be controlled by one organisation'. Another said: 'Because people are only using it for their own systems, it's easy. But when you start getting multiple agencies, multiple partners interacting, that's when it could be helpful. The problem isn't the technology, it's learning to play nicely together'. This raises the very real possibility that the result will be multiple, non-interoperable blockchain platforms that replicate issues of non-interoperability between multiple voucher or cash-based transfer systems (Mercy Corps, 2017).

Third, few DLT projects define the role of actors that are outside or at the margins of the existing humanitarian coordination system, such as local sub-grantee organisations or service providers. Will they be considered peers in the system, or expected to continue to deliver faster services, at increasingly high standards, using a technology they may not fully understand? There is a real risk of accentuating existing inequalities that increase the vulnerability of local actors and their employees. As multiple interviewees pointed out, most, if not all, blockchain

24 Although such discussions regarding DLT are only beginning, other initiatives have attempted to define principles, guidelines, and obligations for the development of new technologies in the sector. See, for example, the Principles of Digital Development (https://digitalprinciples.org/), the Principles of Donor Alignment for Digital Health (http://digitalinvestmentprinciples.org/) and the Signal Code (https://signalcode.org/).

applications have been designed from the perspective of the organisations involved and not the actual recipients of assistance. These changes often result in increased efficiency and savings for the controlling entity but promote only indirect advantages for aid recipients, usually confined to the ability to meet greater needs because of the additional resources available to the aid actor. While end users may experience some benefits, the central point remains that these systems currently do little to effectively change the status of vulnerable individuals and communities.

Before adopting claims of 'distributed aid' or 'peer-to-peer aid', humanitarian actors must consider and be willing to embrace DLTs' consequences: in a perfectly distributed humanitarian system where intermediaries become progressively less active and needed in the network, the role of traditional actors could dramatically evolve or even become irrelevant. Embracing a DLT vision for the humanitarian future implies designing from the outset a new internal, sectoral, and external equilibrium that redistributes power structures across the board. The first step towards this goal is to hold a public and inclusive discussion about how this could and should be done.

4 Moving forward

DLT projects, including blockchain, are appearing with increasing regularity in the humanitarian sector, moving beyond the hype and the overinflated expectations that marked their debut in the field. Completed and ongoing projects confirm that – given the right context and resources – DLTs can be tailored to deliver humanitarian services and ensure satisfactory speed, transparency and accountability, while sometimes decreasing administrative and operational costs. This is especially true for 'back-end' applications. At the same time, serious challenges remain before this technology can be ethically, safely, appropriately and effectively adopted in development and, especially, in humanitarian contexts. This includes improvements in governance models, ensuring that local authorities, communities, and aid recipients are involved in the design, and that processes, policies, and partnerships all support a transition to a distributed digital platform. Investment in joint initiatives aimed at researching and designing humanitarian-friendly innovative solutions could help address several problems currently affecting the DLT system, namely the lack of interoperability and limited ability to scale.

Below, we provide specific recommendations related to these points, with the caveat that this report should represent the beginning – and not the end – of conversations and research aimed at developing models for and solutions to the challenges facing DLT in the humanitarian sector.

Aid actors should consider transparency not only as an outcome, but also as a precondition at the inception of (new) DLT projects.

- Inform recipients, users, communities and authorities about the new technology and its implications, and involve them in the design phase. Seek meaningful consent from those affected by projects using DLTs.
- Serve as positive examples of transparency in the sector by publishing the underlying DLT code, and disclosing cooperation with public authorities and private actors.
- Use open source licences wherever possible to allow public scrutiny of the quality and security of the software, and to allow the formation of communities of practice around the DLT.
- Publish regular updates and lessons learned in a timely fashion, to allow projects to learn from and grow in tandem. Producing and sharing evidence about the use of DLTs in the humanitarian sector is particularly important in understanding impact and barriers to scale. Share assessments and evaluations at the beginning and end of pilots.
- Be clear about project outcomes and how they directly or indirectly result from the adoption of DLTs.

Humanitarians using emerging technologies, especially DLTs, should base their initiatives on evidence.

- Any decision to start a DLT project and the choice of a specific DLT should be based on a multifaceted analysis, including recipients' needs and inputs, internal system inefficiencies, the specifications of the technology solution, the implementation context, data protection risks, and a cost–benefit analysis. This should include a comparison with available alternative solutions, including non-DLT options, before deciding to adopt a DLT solution.
- More research on emerging or untested technologies such as DLTs is needed to build the evidence base. DLT projects should have monitoring and evaluation approaches that examine not only humanitarian impact, but also the selection, design, rollout and functioning of the technology solution.
- Humanitarians should develop stronger partnerships with the public, private and academic sectors, working in partnership with research initiatives (including PhD research) and lab projects to harness the full power of these technologies and consider, evaluate and minimise potential short- and long-term risk.
- Ensure that research reflects a diversity of values, perspectives and backgrounds, to avoid embedding biases in DLT platforms.

Treat the innovation of back-end processes as an opportunity, and front-end ones as a challenge.

- Start by looking for process efficiencies. Most projects identified internal organisational processes that DLT systems were able to improve. In-depth research on the platforms available and how they perform in relation to the targeted functions would allow for easier and safer incremental innovation and lean management tactics.

Humanitarians must carefully consider the design of DLTs, since this fundamentally shapes much more than the way projects are implemented.

- Build a foundation for DLT projects by increasing digital capacity and literacy about problem identification, project design, market assessment, platform selection and project implementation.
- Prioritise DLT systems that are open, transparent, and interoperable, and adopt shared data models.
- Designing emerging technologies in-house from scratch is a higher-risk venture than developing solutions by combining existing services. The latter could prove a better fit if old systems do not serve current goals.
- Design DLT projects and systems in line with existing humanitarian innovation policy and standards, such as the Principles for Digital Development and the Signal Code, as well as humanitarian principles and the IFRC Code of Conduct.
- Decisions about platform design will have repercussions for almost all aspects of DLTs and must be included in the initial framework, notably network resilience to attacks and technical failures, connectivity, digital ID, the distribution of power across the system, security and interoperability.
- Responsibilities, access rights, delegation systems, edit rights, visibility and contribution level need to be quantified and embedded in the DLT system for each partner involved, at least in tentative terms, in the early design phase. Automation and power biases must also be considered and human checks may be required.
- Donors and humanitarian actors engaging with the private sector in DLT development should include interoperability requirements and transparency guidelines in procurement processes. While competition is healthy to support the development of systems, these requirements and guidelines will help to prevent a proliferation of non-interoperable platforms and systems.
- To support the potential to scale smaller pilots, donors should provide multi-year funding that incorporates the option of scaling.

The legal and regulatory space for DLTs represents a significant knowledge gap. Donors and humanitarian actors need to support the development of knowledge in this area.

- While regulatory frameworks are often seen as potential obstacles to unconstrained development of DLTs, aid actors should push for clear and reliable guidelines. Failure to do so could result in wasted resources on platforms that will not survive the introduction of certain regulatory packages, and enables exploration of trade-offs that come from the adoption of DLTs in terms of liability and responsibility.
- Encourage compliance with the strictest regulations. Changes in legislation or the interpretation and enforcement of regulatory frameworks could have consequences beyond the operational viability of a pilot project. For example, derisking procedures applied by banks aim to protect them from liability for transferring resources to individuals included on terrorist lists (Gordon and El Taraboulsi-McCarthy, 2018). No similar system currently exists for DLTs and digital financial transfers, but one could be enacted in the future.
- The humanitarian sector should advocate for clearer, more transparent regulations to be able to roll out DLT projects more rapidly and safely. Donors and policy-makers should promote broad-based initiatives to bring clarity in the sector, for example by providing humanitarians with clear legal frameworks on a broad range of issues, including procurement and reporting requirements.

To 'do no digital harm', include communities, recipients and users at the drawing board stage, and recognise the need to do no harm as a multi-layered and multi-dimensional concept.

- The widespread introduction of GDPR-compliant systems for those who gather PII represents a positive development to protect the privacy of beneficiaries. Yet, just as data about protection outcomes is not equivalent to data protection (ICRC, 2018a), respect for privacy is not the same as protection of civilians and vulnerable persons. The two must be considered separately and in tandem.
- Include end-users in the conceptualisation and design phases of DLT projects. For 'front-end' DLT projects, find ways to engage aid recipients in all phases of the project, from design through to evaluation.
- Develop grievance and reparation policies and mechanisms that are user-specific and appropriate to DLTs and the risks these technology raise.
- Avoid techno-colonialism. Organisational efficiency should not be prioritised over the best interests of local communities and their future, nor should it encroach on their resilience.
- Humanitarians engaged in DLT projects must consider where and how to draw clear lines between project monitoring and management, and surveillance.

Humanitarian actors need to work towards the transformative vision of DLTs and move beyond its reformative potential.

- Aid actors have a significant opportunity to imagine a different, distributed humanitarian system and new ways of helping populations affected by crises. Adopting radical technologies for introducing only reformative patches is a lost opportunity to bring about change.
- Humanitarians should embrace the reality of their intermediary role and dare to envision a humanitarian system in which they are not at the centre and local communities and partners step into primary roles.

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Annex 1 List of interviewees and technical experts consulted

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Saujanya Acharya	World Vision International, Nepal Innovation Lab/Sikka
Guido Baroncini Turricchia	Helperbit
Antoine Bertout	FAMOCO
Michael Casey	CoinDesk/MIT's Digital Currency Initiative
Margie Cheesman	Oxford Internet Institute
Nathan Cooper	IFRC
Paul Currion	Disberse
Chris Earney	UNHCR
Connie Gallippi	BitGive Foundation
Dilek Genc	University of Edinburgh
Jamie Green	WFP
Aradhana Gurung	World Vision International, Nepal Innovation Lab/Sikka
Josh Hallwright	Oxfam
Justin Henceroth	UNOPS
Craig Jolley	USAID
Bernhard Kowatsch	WFP
Aarathi Krishnan	IFRC
Ben Kumpf	UNDP
Cara La Pointe	Beeck Center
Seb Mhatre	DFID
Ruben Mulder	Independent consultant
Sam Ng	WFP
Brent Phillips	One Relief
Gurmeet Philora	OFDA/USAID
Mike Pisa	Center for Global Development
Annemarie Poorterman	Start Network
Ric Shreves	Mercy Corps
Aiden Slavin	Innovation Consultant, IFRC
Kate Strivens	Start Network
Gustav Stromfelt	WFP
Emerson Tan	Mautinoa Technologies
Richard Tighe	Oxfam
Sandra Uwantege Hart	Oxfam
Maarten van der Veen	510
Rogier Verschoor	Oxfam Novib
Tom Wilkinson	DFID
Raul Zambrano	Consultant, NYU GovLab

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