

Blockchain and global challenges: A Roadmap for NGOs



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Acknowledgements:

We are extremely grateful for support from the Edinburgh Futures Institute (EFI), from our colleagues and all those individuals and organisations who have offered their invaluable opinions and insights with us at workshops, roundtables, conferences and interviews.

This paper is a product of two workshops, 'Blockchain Technology and International Development: Challenges, Opportunities and Innovations' held by Oxfam, and 'Blockchain, Trust and Global Challenges' held by the University of Edinburgh Centre for African Studies and supported by EFI, as well as numerous informal conversations with staff in development and environment organisations. In particular we would like to thank:

Josh Hallwright - Program Lead, Australian Humanitarian Partnership (Disaster READY), Oxfam Australia for providing valuable comments on an early draft of this document.

Nic Cary - Co-founder of Blockchain, UNDP Blockchain Commission for Sustainable Development

Jessi Baker - Founder, CEO Provenance

Professor Chris Speed, University of Edinburgh

Dr Chris Elsdon, Northumbria University, Newcastle

Dr Larissa Pschetz, University of Edinburgh

Dr Jamie Cross, University of Edinburgh

Dr Peter Howson, Nottingham Trent University

Ric Tighe, Oxfam ICT

Houman Haddad, World Food Program, Building Blocks

Miriam Denis Le Seve, Overseas Development Institute

Jack Robinson, Sustainia

Summary

Blockchains are distributed ledger technologies which enable the secure, transparent sharing of data and processing of transactions among multiple actors that may not know or trust each other.¹

Definition:

Blockchains may improve any process where multiple parties need to access, verify, send or store information securely. This information could be a person's identity, a product's supply-chain history, a digital asset like money, or an algorithm (a 'smart contract') which automates a contractual relationships between parties. Traditional, centralised, databases can also store such information, but are opaque and vulnerable to unauthorised access, distribution or deletion.²

Promises:

Blockchains may provide new ways to make humanitarian and development aid more transparent, provide secure identities and asset registries in unstable contexts, make food and other supply chains fairer for producers, and create new models to manage natural resources. More broadly, blockchains may radically change the way that value is exchanged (through digital tokenization), and may shift power relations in economies (through decentralized and automated governance). These characteristics could provide new ways to address the Global Goals.³

Challenges:

Despite the optimistic claims made for blockchain technologies, there has been remarkably little practical information to guide non-government organisations (NGOs) and other bodies working in environment and development who may be interested in exploring these opportunities. Drawing on practical experience and research, this paper summarises the immediate and longer-term challenges and opportunities for such organisations.

Purpose:

We look beyond the well-rehearsed promises of absolute transparency, accountability and efficiency to help inform organisations of both the practical applications and the associated technical, ethical, organizational and political challenges of blockchain, as well as providing a road map towards potential adoption.

¹Wladawsky-Berger, I. The promise and current state of blockchain, Wall Street Journal (2018), available at: <https://blogs.wsj.com/cio/2018/05/11/the-promise-and-current-state-of-blockchain/>

²Wigley, B., and Carey, N., The Future is Decentralised, UNDP (2018), available at: <http://www.undp.org/content/dam/undp/library/innovation/The-Future-is-Decentralised.pdf>

³Kewell, B., Adams, R. & Parry, G. Blockchain for good? Strategic Change 26, 429–437 (2017).

Introduction

What is blockchain technology?

Blockchains are a family of technologies – distributed ledger technologies, or DLTs - which can create databases of any kind of information which users can trust, even if users do not know or trust each other. Blockchains enable people and organisations to exchange and store digital information without needing to trust a specific actor to look after the data, and without worrying that other people might fraudulently change it. Because all transactions are recorded through secure cryptography in a distributed database, transaction histories can also be made transparent. This means it is possible to create and exchange purely digital goods (such as tokens or currencies), create trusted digital databases of records, create digital personal identities, track supply chains and establish new networks of exchange. Blockchains may change the way we exchange value in the same way that the Internet changed the way we communicate.

Blockchains were developed in 2008 as the technology underpinning the cryptocurrency Bitcoin. While Bitcoin is just one way of using blockchains (much in the same way that social media is just one way to use the Internet), the currency is a good way to understand the technology, and it is to date its most successful application. Unlike how banks records transactions in their own separate databases, with a cryptocurrency the entire transaction history of every user is recorded in a single database. This database is shared across computers throughout the network, and for a transaction to succeed, these computers need to 'agree' that the transaction is valid. In the case of Bitcoin, this is achieved through checking that the sums of each user matches existing records. If they agree, information about the transaction, and other recent ones, are grouped together and sealed in blocks. Each new block is then added to the previous one to form a chain, and each distributed around the network and added to everyone's copy of the chain simultaneously. Because it is nearly impossible to fraudulently change every record in the network at the same time, or to go back and change the information in previous blocks, users can't spend Bitcoin they do not own. The result is a secure currency which does not need to be validated by any nation state or bank.

Blockchains also integrate with other novel digital technologies, and many of the more ambitious claims around automation and decentralized

economies involve integrating blockchains with these novel solutions, in particular, smart contracts and the Internet of Things (IoT). Smart contracts are algorithms which store and enact contracts in an 'if this, then that' formula. This means that transactions (e.g. payments) could be made conditional on certain requirements being met. To take an example from conservation and community development, if a particular level of forest density is recorded, a community payment is made. The Internet of Things involves devices and machines linked to the Internet to sense and enact automatic protocols. This could include every-day items like household appliances, along a myriad of other machines such as those used in the supply of humanitarian aid and the management of resources being part of automatic economies and governance systems. The easiest way to understand the possibilities of blockchains and their associated technologies are through examples and use cases, discussed further in this paper.

What are blockchains good for?

The reimagining of financial transactions and ability to store trusted digital records initially demonstrated in Bitcoin has led people identifying blockchain solutions for many sustainable development targets, and many different applications for businesses, governments and NGOs.

Blockchain technologies are interesting to the development and sustainability sectors because they introduce characteristics that are very different from conventional ways of exchanging items and recording assets. These are:

1. No third parties: Users in a blockchain system can transact directly with each other without middlemen. This can provide secure and cheap international remittances, direct peer-to-peer giving, new national crypto-currencies, and even 'ethical money' (e.g. money that does not pass through particular regimes, locations or corporations).
2. Trust: As there are no third parties and transactions are transparent, trust in a blockchain system is greatly increased. Through recording all transactions on a ledger that all users can read, aid money could be traced through its users, providing increased transparency to donors

and recipients. It could also enable money to be tracked through a series of exchanges, giving new insight into secondary aid impacts and effectiveness.

3. Recording and exchanging new assets: Blockchain can represent values and assets, such as the secure registry of assets like land or personal identification. This could reduce land disputes and enable greater access to services like banking.

4. Automation: Development funding could be governed by smart contracts between recipients, providers and donors, meaning that outcomes or values could be automatically programmed into aid relationships (bringing in IoT and smart contracts).

5. Ethical supply chains: Through making the provenance of items and components in a supply chain transparent, blockchain can enable organisations to have trustworthy supply chains.

These characteristics combine to create new possible economic and governance models.

Token economies

By effectively creating digital scarcity, blockchains have also enabled new forms of economic exchange.

Digital tokens representing anything can now be created and exchanged. As digital payments do not respect national borders, international payments, remittances or donations, as well as micro-payments can be made more frictionless. New markets and new exchange relations between actors can be also be created, but whether these 'token economies' persist remains to be seen.

Automatic and Decentralised Governance

Blockchain can provide institutions with new ways to operate (for example, creating digital property records or digital identities) and can enable transformative systems of governance, some of which could potentially exist without such institutions (by being automated organisations).

Some promises, such as improved supply chain and financial transparency, would likely complement existing governance structures, whereas others (such as digital sovereignties, digital democracy and conditional payments) are more radical and transformative.

How energy-hungry are blockchains?

The energy consumption of a blockchain depends on its complexity.

Recent media reports suggested that blockchain technology risks becoming a major energy consumer.

The Bitcoin blockchain is a permissionless blockchain. It is very energy-intensive as its high level of security comes from all its users completing increasingly complex mathematical problems to create the blocks in a process known as mining.⁴

In contrast, permissioned or private blockchains often do not require the same energy use as they require participants to have some kind of permission to access the blockchain (reducing the need for intensive cryptography).

There may, however be a tradeoff in the functionality of the blockchain, especially around open access and transparency.

Maybe NGOs and other collectives are more likely to use private blockchains or hybrid systems, which require less energy. And, the use of blockchains must be placed in the context of the energy consumption by conventional data technology, which is itself significant.⁵

⁴Hern, A. (2018). Bitcoin's energy usage is huge – we can't afford to ignore it. The Guardian, Wed 17 Jan 2018. Available at: <https://www.theguardian.com/technology/2018/jan/17/bitcoin-electricity-usage-huge-climate-cryptocurrency>

⁵Morley, J., Widdicks, K. and Hazas, M., 2018. Digitalisation, energy and data demand: The impact of Internet traffic on overall and peak electricity consumption. Energy Research & Social Science, 38, pp.128-137.

Blockchains for Global Goals

There are presently several start-up enterprises which have launched platforms using blockchains and other digital technologies to help meet the Global Goals for Sustainable Development. There are also a number of larger non-government organisations such as the International Union for the Conservation of Nature (IUCN), the World Food Programme (WFP) and development NGOs including Oxfam which are

using, or exploring the implications of blockchains for their work. Here we summarise the characteristics of blockchains, and the ways in which they are being, or could be used to meet specific Global Goals. We then go into more detail in three areas; humanitarian aid, changing power dynamics in supply chains, and creating incentives for conservation.

Application	Description	Example Goals
Money and Aid Banking and Payments Philanthropy Development Aid	<p>Cryptocurrencies can bring financial services to the unbanked and may reduce transaction fees for international payments. Other possibilities include micro-finance, welfare payments and inter-organisational transfers.</p> <p>Peer-to-peer donations are enabled, and increased transparency may increase engagement and/or trust. Payments can be made conditional or performance based.</p> <p>Increased transparency might reduce corruption, payments can be automatically disbursed (e.g., to disaster zones or verified individuals)</p>	
Tokens and exchange Utility markets Conservation incentives	<p>Tokenization can create peer-to-peer trading and distribution networks, such as for local or green energy, and water.</p> <p>Natural assets, and/or conservation actions could be tokenized and sold in digital marketplaces. Payments could also be automated if certain conditions achieved (e.g., forest growth).</p>	
Digital records Identity Health Legal	<p>Provision of digital identities, for identity-less and vulnerable individuals, including refugees.</p> <p>Health data could possibly be digitised and stored safely for individuals.</p> <p>Possibility of recording property rights, other assets, voting and making other forms of governmental information more transparent.</p>	
Supply chains Wildlife products Emissions Human rights	<p>Registering products, and production conditions to a blockchain at the point of source, enables their movements to be tracked down a supply chain.</p> <p>Fairer systems of exchange between producers and consumers may also be created through enhanced transparency and the use of smart contracts.</p>	
Radical governance Decentralised Autonomous Organisations Digital commons	<p>Smart contracts automate digital processes and transactions, leading to the creation of decentralised organisations that carry out functions to maintain themselves.</p> <p>New forms of exchange may enable re-commoning and digital/economic organisation between people and digitally connect 'things'.</p>	

Figure 1: Blockchains for Global Goals

Example 1: Blockchains in Humanitarianism



The most advanced blockchain pilot at present in the humanitarian sector is the World Food Programme's Building Blocks. It operates in Jordan and currently supports around 100,000 Syrian refugees (looking to expand to 500,000 in 2019). Building Blocks is a cash-based transfer program which uses blockchain technology in the back-end. The scheme replaces cash-based transfers (currently conducted through giving pre-paid cards attached to conventional bank accounts to refugees) with a blockchain system. The existing process is costly, slow, and requires the WFP to provide beneficiaries' information to a third party (the bank), but the new system is cheaper and more efficient. A beneficiary now enters a selected store and has their iris scanned to identify that they are a part of the programme. Once positively identified, the beneficiary can make purchases which are then recorded on the WFP's Ethereum permissioned blockchain. The WFP's blockchain will add all the transactions up and then the WFP will transfer the shop the money they owe, directly from the WFP's bank account to the shop's bank account (Figure 2).

This process means the WFP can better control the list of beneficiaries and no longer needs to share

their details with a third party. There are also large savings - 98% of local bank costs - from not having to do reconciliation with the bank's data and not having to pay administrative fees.

Considered a success by many in the aid sector, Building Blocks is being scaled with planned expansion to four more countries, and to be applied to all refugees in Jordan. With regards to its use of blockchain technology, this project has been criticised as just functioning as a centralised database which does not utilise all of blockchain's potential. However, it is an example of starting off with simple applications of blockchain with the view to testing, iterating and expanding. More serious might be the emerging ethical concerns around using blockchains to administer refugee and humanitarian matters.

Advantages:

- Significantly reduced costs, greater speed and efficiency in money transfer.
- Better knowledge of beneficiaries for WFP, and increased security for beneficiary identity.
- Simple and useful application of blockchain with scope to scale up in its current format, and be developed into inter-agency models.

Disadvantages:

- The programme does not use all of blockchains' functions (with detractors asking why a blockchain is therefore necessary).
- Ethical concerns are emerging regarding requesting and storing refugee's biometric data.

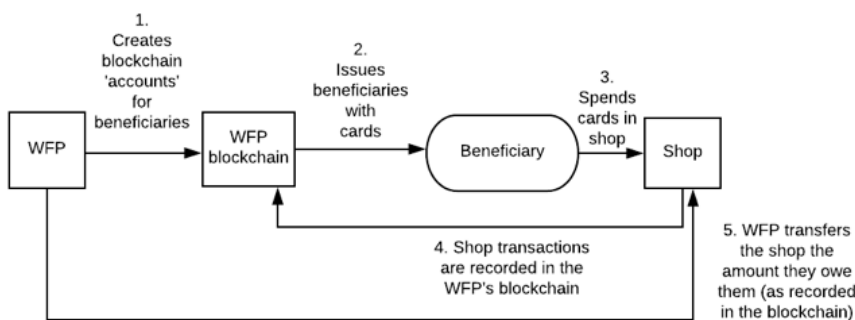
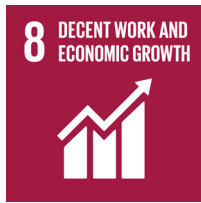


Figure 2: Blockchains in humanitarian aid distribution

Example 2: Changing power dynamics in supply chains



Many organisations have recognised the potential to use blockchain to increase environmental sustainability and empower labourers and producers in supply chains. This can be achieved through smart contracts hosted on blockchains which can securely perform transactions if particular conditions are achieved and recorded (such as ethical production or fair distribution of benefits to labourers). There are two main formats through which this could work. The first is through promoting transparency in a supply chain through certifying ethical production conditions. Startups like Provenance, and existing NGOs such as WWF are trying to increase supply chain transparency using blockchain. The idea is to track products using tokens, from source to plate, with the goal of increasing consumers' knowledge about the source of the product, and making ethical production and labour relations transparent. In the case of Provenance, ethically-caught tuna is tracked

through a supply chain via blockchain technologies, while Everledger uses blockchains to certify that diamonds come from trusted mines. The idea here is that more consumers would choose to buy from ethical, transparent supply chains.

The second, related format is to facilitate direct payments from consumers to suppliers, particularly in food production. At present, trading dynamics between small-scale food producers in developing countries assume trading dynamics based on historical inequalities, with economic benefits from agricultural commodity production going to large corporations in the global North, facilitated by middlemen, while farmers see squeezed values for the raw produce. There is significant potential for blockchains to support development in a bottom-up manner through promoting new local and regional markets for value-added products in food and other areas. Blockchains can be used to enable small co-operatives to make and receive trusted and secure payments, with platforms such as AgUnity suggesting that blockchains help supporting the growth of local food production and increasing small farmers' income.

Advantages:

- Appropriate use of the technology to demonstrate transparency and enhance trust in ethical claims.
- Supports value-added development through facilitating direct payments to producers and labourers, cutting out middlemen and large centralized businesses (decentralization).

Disadvantages:

- Use of data technologies must be used carefully in relationships of differential power
- The quality of the platform depends on the data inputted.
- Does not solve wider political problems of insecure land tenure and climate insecurity
- International supply chains may encounter many different (and fast-changing) regulation regimes.

Example 3: Conservation Incentives

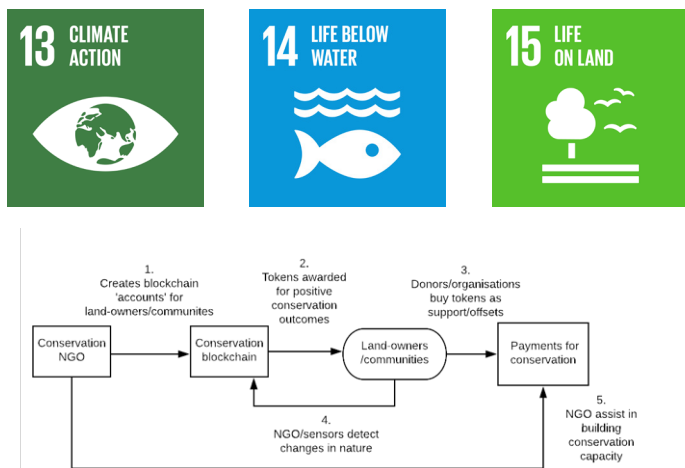


Figure 3: Blockchains in community conservation incentives

Recently, organisations have identified the ability to use blockchains and related technologies in the conservation of habitats and biodiversity. There are clear potential use cases in two distinct, yet related, areas of conservation: (a) Tracking and making conservation payments to landowners or conservation communities; (b) Automating the management of habitats and ecosystems via remote sensing and smart contracts; These different uses can be used together, as illustrated in figure 3, or used separately.

In the abstract illustrated here (which is similar to the IUCN's Green List project), a conservation NGO could use blockchain technologies to create accounts for land owners (in the case of community-based conservation, this could be a local community). This blockchain could store land tenure information and identities of payees to ensure transparency,

and it would also contain agreements (using smart contracts) which automatically reward communities for positive conservation outcomes such as increased forest cover, or a species presence growing. The use of blockchains could thus secure rights for communities and incentivize positive behaviours, perhaps leading to greater democracy and accountability in conservation. A next step is to include automatic and remote sensing via the Internet of Things. Conservation outcomes could be something ascertained remotely using sensors which detect changes such as increases in forest cover, reducing the administrative and management burden for disbursing conservation funds.

However, there are many problems and barriers to these uses. The use of blockchains to record land rights and make payments for the sustainable management of the resource is only effective if actors agree over land tenure. Land rights continue to be a contested area in the Global South, and introducing blockchain to create conservation accounts for landowners could exacerbate rather than solve land disputes⁶. Similarly, the track record of conservation in making effective and fair payments to communities has long been debated, and the link between conservation payments and positive and equitable development is unclear⁷. Furthermore, ecosystems are highly complex, and the possibility to manage these via remote sensing and algorithm is unproven⁸. Overall, while these new possible incentive and governance structures for conservation may increase accountability and the amount of funds flowing into conservation, they remain to be tested.

Advantages:

- Opportunities which range from the relatively straightforward (transparent community payments) to the ambitious and untested (autonomous ecosystems).
- May enhance transparency in conservation management.
- Provides tangible links between positive conservation behaviours and benefits, increasing trust in conservation governance.

Disadvantages:

- Land tenure, resource use and conservation are political issues which technology alone cannot solve.
- Incentivisation via payments is already being deployed in conservation without the use of blockchains, with mixed results.
- Gimmicky, if not accompanied by a clear need and in-depth knowledge of the context.

⁶Hall, D. (2013). Primitive accumulation, accumulation by dispossession and the global land grab. *Third World Quarterly*, 34(9), 1582-1604.

⁷Adams, W.M. and Hutton, J., 2007. People, parks and poverty: political ecology and biodiversity conservation. *Conservation and Society*, 5(2), pp.147-183.

⁸Adams, W.M., 2017. Geographies of conservation II: Technology, surveillance and conservation by algorithm. *Progress in Human Geography*, p.0309132517740220.

Technical, ethical and political challenges

Technical and Organisational

Decentralisation often increases complexity, and in some instances blockchains create inefficiencies. Rather than one actor verifying records, blockchains require multiple actors to carry out this function using a consensus protocol, which requires time and computational resources. The most popular current consensus protocol is proof-of-work, which is very expensive and energy-hungry, leading to concerns around increasing energy-usage and carbon emissions. Similarly, moving from data silos to distributed networks often require adding layers of encryption, which can be more computationally expensive⁹. Additional off-chain solutions may be required due to the cost of permanently storing data on an ever-growing blockchain and the need to manage access to blockchain data.

Popular blockchains have faced scaling issues due to the rapid increase in transaction fees as more people use the network. Combined with highly volatile prices (due to speculation and possible market manipulation) and security breaches (exchange hacks) blockchain solutions are still widely perceived to be risky. There are also serious concerns over dealing with erroneous, fraudulent or otherwise unwanted data in supposedly tamper-proof databases. This has also led to the rise of the popular axiom, 'rubbish in, rubbish out' regarding any form of digital record keeping.

Our engagement with large NGOs also indicates organizational challenges. There has been a struggle to encourage those in leadership and management roles to engage with the technology and to fully explore its implications (both for the organization itself, and for the wider context in which it operates). This may be from a risk aversion (particularly given that blockchain remains conflated with cryptocurrencies), and also due to ongoing and pressing operational demands. We have also seen an uneven attitude to risk, with organizational strategy on blockchains depending on ad hoc interest from senior figures.

As a result of these technical and organizational challenges, some NGOs appear to be waiting for the commercial sector to 'crack' the blockchain. For such organisations, waiting may have advantages in reducing risk, but it could come at the cost of reduced input in the creation of new systems of

governance, and possibly ending up as dependent on new, external, monopolies.

"Computationally expensive"
"Scaling difficulties"
"Speculation and perverse incentives"
"Rubbish in, rubbish out"

Ethical and Legal

Blockchain is designed to be 'immutable', meaning that it is very difficult to alter information once it has been recorded in the ledger. As such, when entering information into the blockchain, one must be comfortable knowing that it might never be deleted. Legally, this could fall foul of the General Data Protection Regulations (GDPR) 'Right to be forgotten', which allows individuals to request that organisations delete their information if it contains personal identifying information.

There are further legal and ethical questions as to whether consent for personal data to be stored, is freely given in circumstances where receiving aid or assistance is contingent on consenting to the use of blockchain.

Public blockchains are designed to allow the public to view the transactions and records. Although these transactions can be encrypted and the users' identities pseudonymised, neither of these are infallible, meaning that they could eventually be traced and identified. Digital rights and the GDPR are relatively new concepts and laws. As blockchain is a new technology, there is not much statutory or case law on the applications of blockchain and the boundaries are not quite clear. As such, it is currently not advisable to store personal identifying information in a blockchain, and to be particularly careful when piloting blockchain projects which involve vulnerable subjects such as refugees.

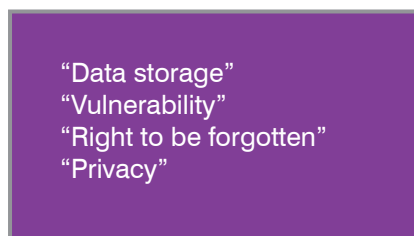
There are also ethical questions concerning how blockchain platforms and enterprises engage with developing countries and communities.

⁹ Elsdon, C., Manohar, A., Briggs, J., Harding, M., Speed, C. and Vines, J. Making Sense of Blockchain Applications: A Typology for HCI. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems ACM (2018).

Research into technology, and the subsequent interventions, have often silenced perspectives from the Global South.

This is through structural exclusion, for example, making academic literature and technical resources so expensive that only scholars affiliated with rich institutions can keep up, and through predominantly Northern researchers dominating research. It is also through researchers operating an extraction model based on superficial interactions which views communities in developing countries as 'living laboratories' and test cases for their proposed schemes¹⁰.

The challenge for blockchain researchers is to ensure they conduct research in ethical and participatory ways, particularly if the goal is to deliver humanitarian aid through blockchains.



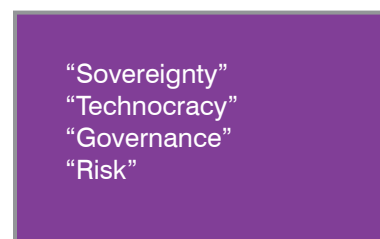
Political

One of the biggest barriers facing blockchain applications is regulatory uncertainty¹¹. Introducing new currencies may challenge national sovereignty. Cryptocurrencies do not respect international borders and can be exchanged pseudonymously, meaning it is out of reach of the government, tax and banks.

Any NGO considering using cryptocurrency should therefore be aware that national governments may consider it an encroachment on their sovereignty, and in some countries, illegal.

The process of decentralisation can also be inherently political. Many of the crypto-evangelists share libertarian ideology, which seeks small government, free-trade and deregulation. Many of these ideals are enshrined into the code and governance structures of blockchains. Far from replacing the need for trust, to some extent, blockchains act to displace trust from legacy institutions, towards those writing the code. Such 'disruption' might come to resemble technocracy and may be associated with reduced democratic freedoms if not carefully designed. This may particularly be the case if the access to, and/or understanding of this technology is restricted.

These political implications will change the environment in which NGOs operate. This includes possibly examining their own position as centralized intermediary and development expert. NGOs may also wish to consider how they help their partners respond to and shape wider societal changes. This involves early engagement with what is currently a risky technology, despite some evidence that NGOs may wish to step back in these early stages and let the private sector shoulder the risk.



¹⁰Adams, G. 2014. 'Decolonizing Methods: African Studies and Qualitative Research'. Journal of Social and Personal Relationships, 31 (4). pp.476-74.

¹¹Pisa, M. Reassessing Expectations for Blockchain and Development. (2018).

Blockchain decision tree

Does your project or organisation need a blockchain?

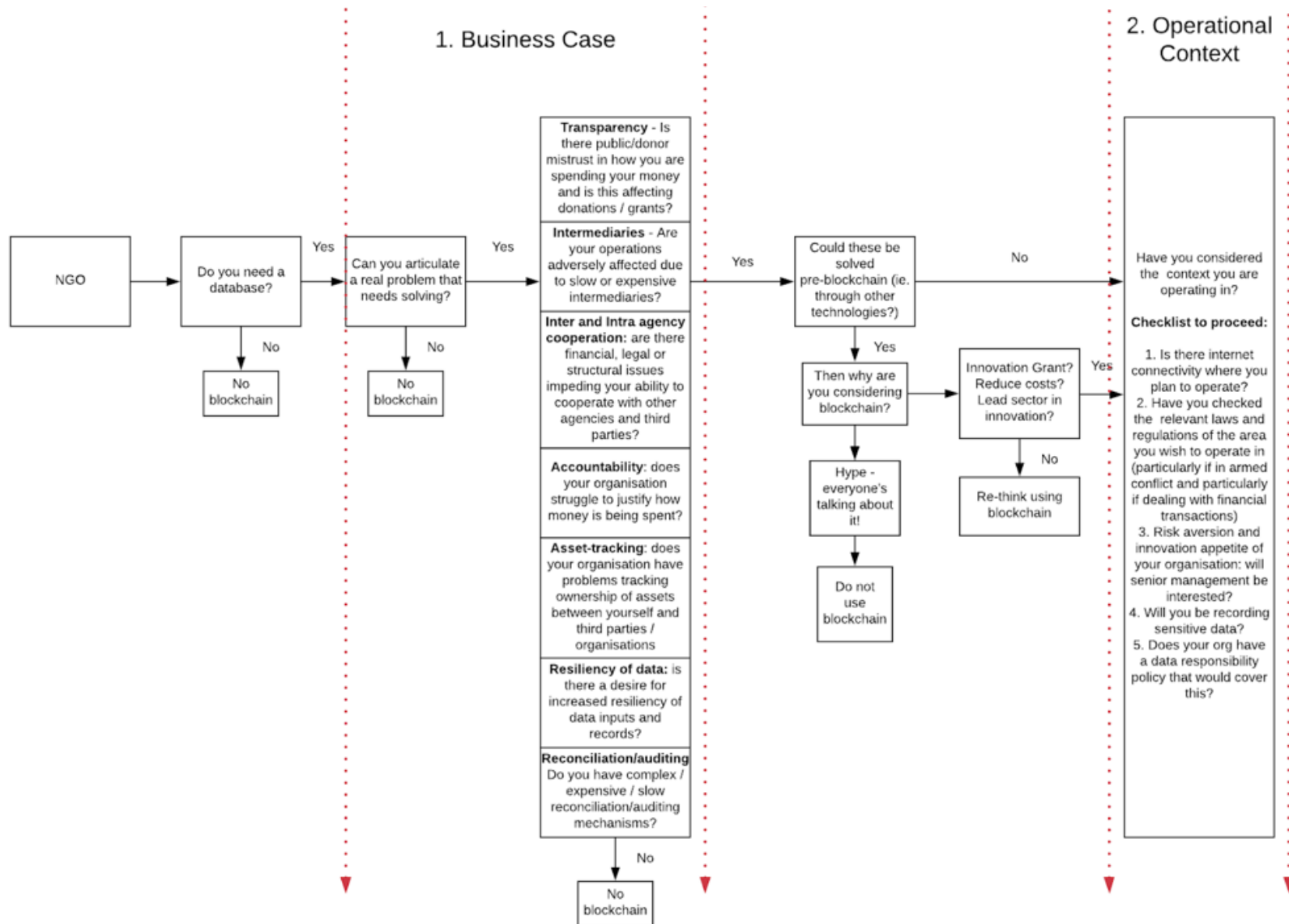


Figure 3: Blockchain decision tree and checklist for NGOs. Follow this flowchart to ascertain the need for a blockchain. For full and updated and interactive decision tree see <https://blockchain.humanityx.nl/>

Recommendations

Blockchain technology enjoys a paradoxical reputation as both the solution to almost every global challenge, and the solution to none. The list of promised applications vastly outweighs the number of existing actual pilot projects. In turn, the number of actually working pilots and projects is extremely small.

The interest around blockchains may in part be driven by technical illiteracy (making it hard to discern what is and what is not possible) and partly the desire for organisations to be innovative in addressing challenges. We suggest that blockchain technologies evoke a wider idea: that new forms of cooperation, humanitarianism and sustainability are both possible, and urgent.

Blockchain technology is still in the experimental phase. This presents both a danger and opportunity to NGOs seeking to address the Global Goals. There is a clear risk that hasty, ill-thought out applications may be launched which are socially and environmentally damaging, but at the same time, there is an opportunity for NGOs to engage in this experimental phase to advise and guide projects towards being truly equitable and sustainable. The transformative potential of the technology must not be overlooked, and while blockchains are no substitute for the institutional and interpersonal trust developed by NGOs over decades, they may provide NGOs with the ability to work in new, possibly more effective ways.

We recommend that NGOs considering using blockchains and its related technologies consider the following next steps:

1. Establish a clear need and use-case by following part 1 of the blockchain decision tree. Blockchain technologies are presently most effective at increasing efficiency and trust in value transactions, so a use-case should be based on a trust deficit.
2. Start small – look to test a blockchain-based system through simple transactions rather than aiming for a transformative effect.
3. Ensure that you have a clear understanding of a concrete problem, and an in-depth appreciation of the different stakeholder positions involved.
4. Check the ethical, regulatory, legal and risk considerations for your context (listed in part 2 of the blockchain decision tree).
5. Engage early to ensure the use of blockchains remains diverse and ethical, rather than consolidated by a few large companies. Early engagement also means NGOs can have a voice in the emerging and still uncertain regulation and governance of blockchains, and can start to advocate for positive outcomes for the contexts and communities they work for.
6. Ensure blockchains and other emergent decentralizing technologies form part of your strategies, both within your own organisation, and in your arena of operation.
7. Find like-minded partners through the University, governmental, private and NGO sectors by attending blockchain panels and conferences and working with interagency groups (such as the Start Network).