Chapter 6

Leveraging Blockchain Technology to Build Resilience and Disaster Risk Reduction in Small States

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Blockchain is a foundational emerging technology of the Fourth Industrial Revolution, much like the internet was for the previous (or third) industrial revolution. Its defining features are its distributed and immutable ledger and advanced cryptography, which enable the transfer of a range of assets among parties securely and inexpensively without third-party intermediaries. Blockchain is more than just a tool to enable digital currencies. At its most fundamental level, it is a new, decentralised and global computational infrastructure that could transform many existing processes in business, governance and society and also be an enabler to solve some of the world's challenges.

Countries today face numerous challenges. Economic globalisation, migration, demographic changes, environmental issues and climate change are placing all countries, no matter their size or wealth, under constant pressure. The recent economic and financial crisis has not only uncovered the high level of interconnectedness between economies and the volatility of the global economy, but has underscored the need for effective political capacity to steer policy. It has shown that all countries are vulnerable to global economic shocks in a globalised world. We also know that some countries, particularly small states, are inherently vulnerable to external shocks (Briguglio 1992, 1995, 1997, 2003). What matters in today's world is the strategy and capacity to respond to these adverse shocks. This ability to respond is described by Briguglio et al. (2006) as 'resilience'. Technology advances such as blockchain can be important enablers for building resilience in various areas, including disaster risk reduction.

If harnessed in the right way, blockchain has significant potential to enable a move to cleaner and more resource-preserving decentralised solutions, and unlock natural capital and empower communities with a view of building resilience to environmental and natural shocks, including disasters.

6.1 The nexus between small states, vulnerability and disasters

Many small island states are highly vulnerable to natural disasters and some face unique challenges due to the rising sea level. In fact, studies have shown that small states are proportionately more vulnerable to natural disasters. According to a study conducted by the International Monetary Fund (IMF 2016), using the most widely used database on natural disasters (EM-DAT), the economic cost of the average natural disaster during 1950 to 2014 was equivalent to nearly 13 per cent of gross domestic product (GDP) for small states compared to less than 1 per cent of GDP for larger states. Similarly, the average natural disaster affects 10 per cent of the population in small states, compared to 1 per cent for other countries. This study (ibid) also found that this greater vulnerability of small states applies to almost all categories of natural disaster. Across a wide range of disasters (except extreme temperatures), an occurrence in a small state is proportionately more damaging than an equivalent event in a larger state, making the recovery in the aftermath of a disaster more challenging. For example, a disaster-level storm is 23 times more damaging than for large states, measured as a share of GDP. This partly reflects the large number of small developing states that are islands, so that when a storm makes landfall, it affects a larger proportion of the population. Greater damage may also reflect the more constrained fiscal space of small states, which can preclude adequate advance investments in risk reduction.

Disasters not only cost more in small states but are also more frequent. Ranked by frequency of disasters in relation to land area, IMF (2016) found that in its sample, 21 of 33 small states were in the global top-50. Small states, as a consolidated group, experienced 460 disasters between 1950 and 2014, an average of seven disasters within the group each year. By contrast, eight countries with a roughly similar overall land area to the combined small states experienced only 66 disasters over the same period, or roughly one each year. The higher frequency of disasters partly reflects the unfavourable geographical location of many small island states.

IMF (2016) concludes, reflecting frequency and impact, the cost of disasters over time is higher for small states. Over the last 25 years, the annual damage (including both disaster and non-disaster years) averaged 1.8 per cent of GDP for small states compared to 0.4 per cent of GDP for other countries. The cost, researchers say, is most probably underestimated.

In terms of economic vulnerability, these adverse weather events represent an extreme form of a supply shock and can have macroeconomic effects that are both large and long-lasting. Fabri (2014) found that natural disaster management was one of the most pressing challenges that small island states were facing, especially from a governance perspective. The literature describes the cycle of loss and recovery as a three-stage process. The first stage involves direct losses from the destruction of infrastructure and property. In the second stage, indirect losses accumulate from foregone output and incomes, and costs are incurred as individuals and business work around disruptions. Finally, as the recovery starts, rebuilding of infrastructures and replacement of damaged goods leads to a temporary boost in activity and employment in the affected areas. Nonetheless, various studies have classified the main economic impacts as follows:

- Natural disasters have a clear temporary impact on growth (Raddatz 2007; Noy 2009; Acevedo 2014; Cabezon et al. 2015).
- Evidence on the impact of natural disasters on underlying long-run growth is more mixed (Cavallo and Noy 2010).

- Fiscal balances tend to be adversely affected (Cabezon et al. 2015; Acevedo 2014).
- External trade balance also tends to worsen (Rasmussen 2004; Cabezon et al. 2015).

Differences in the cost of natural disasters have been attributed to institutions, as well as initial economic and financial conditions. Noy (2009) asserts that institutions directly affect the efficiency of the public intervention following a disaster or the indirect impact by shaping the private sector response. This response or the ability to respond is defined by resilience. Technology and leveraging latest technologies and the synergies between them can enable countries to build their resilience, improving their responsiveness to natural disasters.

6.2 The role of resilience

'Resilience' refers to a country's ability to recover quickly from a negative external shock (Briguglio et al. 2006). Unlike vulnerability, an inherent characteristic for small states – particularly island states – is that resilience is nurtured. Resilience takes on greater significance in countries that are inherently more exposed to external shocks, such as small island states.

In this context, resilience is indeed a pre-condition for economic growth and development. By building resilience, people, communities and governments will be equipped with the capacity to cope, act and rise to the challenges of the twenty-first century.

Building resilience is a transformative process that builds on the capacity of individuals, their communities and institutions to lessen the impacts of shocks, internal or external, natural or human-made, economic, health-related, political or social. Briguglio et al. (2006) argue that economic resilience depends upon appropriate policy interventions in four principal areas, namely: macroeconomic stability, microeconomic market efficiency, social development and governance. Although as a concept it was not included in the original index, good environmental management is also considered to be contributor to resilience.

The literature suggests that good governance has an important and central role in building resilience, especially in small island states (ibid). Building on these findings, Fabri (2007) found a significant development dividend of good governance, where any improvements in governance would lead to a multiplier effect on per capita incomes.

6.3 Blockchain and distributed ledger technology

Throughout the past couple of years, blockchain has been the source of much interest and excitement. This new technological revolution is promising to usher in a new era that will shake up a number of industries, including financial services, logistics, identity and government services. Fuelled by the hype and volatility of Bitcoin, blockchain has also been seen as a new vehicle through which to raise capital through the now infamous Initial Coin Offerings or Security Token Offerings (STOs). Prior to looking at how blockchain can also enhance disaster resilience, it is appropriate to provide an overview of blockchain and the broader distributed ledger technology (DLT) it is part of.

DLT comes on the heels of several peer-to-peer (P2P) technologies enabled by the internet, such as email, sharing music or other media files, and internet telephony. However, internet-based transfers of asset ownership have long been elusive, as this requires ensuring that an asset is only transferred by its true owner and ensuring that the asset cannot be transferred more than once, i.e. that there is no double-spend. The asset in question could be anything of value.

In 2008, a landmark paper written by an as-yet unidentified person using the pseudonym Satoshi Nakamoto, 'Bitcoin: A Peer-to-Peer Electronic Cash System', proposed a novel approach of transferring 'funds' in the form of 'Bitcoin' in a P2P manner. The underlying technology for Bitcoin outlined in Nakamoto's paper was termed 'blockchain', which refers to a particular way of organising and storing information and transactions. Subsequently, other ways of organising information and transactions for asset transfers in a P2P manner were devised – leading to the term 'distributed ledger technology' (DLT) to refer to the broader category of technologies.

DLT refers to a novel and fast-evolving approach to recording and sharing data across multiple data stores (ledgers), which each have the exact same data records and are collectively maintained and controlled by a distributed network of computer servers, which are called 'nodes'. One way to think about DLT is that it is simply a distributed database with certain specific properties. Blockchain, a particular type of DLT, uses cryptographic and algorithmic methods to create and verify a continuously growing, append-only data structure that takes the form of a chain of so-called 'transaction blocks' – the blockchain – which serves the function of a ledger.

New additions to the database are initiated by one of the members (nodes), who creates a new 'block' of data, for example, containing several transaction records. Information about this new data block is then shared across the entire network, containing encrypted data so transaction details are not made public, and all network participants collectively determine the block's validity according to a pre-defined algorithmic validation method (the 'consensus mechanism'). Only after validation, all participants add the new block to their respective ledgers. Through this mechanism, each change to the ledger is replicated across the entire network and each network member has a full, identical copy of the entire ledger at any point in time. This approach can be used to record transactions on any asset which can be represented in a digital form. The transaction could be a change in the attribute of the asset or a transfer of ownership.

Two core and game-changing attributes of a DLT-based infrastructure are:

i. the ability to store, record and exchange 'information' in digital form across different, self-interested counterparties without the need for a central record-keeper (i.e. peer-to- peer) and without the need for trust among counterparties; and

ii. the ability to ensure there is no 'double-spend' (i.e. the same asset or token cannot be sent to multiple parties).

In the right context, distributed ledgers can potentially have a number of advantages over traditional centralised ledgers and other types of shared ledgers. The most important potential advantages of DLT are listed below, though generalisations are difficult because of the large variety of designs and specifications that permissioned and permission less blockchains can have:

- **Decentralisation and disintermediation**. DLT enables direct transfers of digital value or tokens between two counterparties and decentralised record-keeping, removing the need for an intermediary or central authority who controls the ledger. This can translate into lower costs, better scalability and faster time to market.
- **Greater transparency and easier auditability**. All network members have a full copy of the distributed ledger (which can be encrypted). Changes can only be made when consensus is established, and they are propagated across the entire network in real-time. This feature, combined with the lack of a central authority or limited involvement of a central authority, has the potential to reduce fraud and eliminate reconciliation costs.
- **Automation and programmability**. DLT enables programming pre-agreed conditions that are automatically executed once certain conditions hold. This is referred to as 'smart contracts': for example, invoices that pay themselves when a shipment arrives or share certificates which automatically send owners' dividends.
- **Immutability and verifiability**. DLT can provide an immutable and verifiable audit trail of transactions of any digital or physical asset. While in most cases, immutability is desirable, it can create problems related to recourse mechanisms if the system fails.
- **Gains in speed and efficiency**. DLT offers the potential of increasing speed and lowering inefficiencies by removing or reducing frictions in transactions or in clearing and settlement processes by removing intermediaries and automating processes.
- **Cost reductions**. DLT offers the potential for significant cost reductions due to removing the need for reconciliation, as DLT-based systems by definition contain the 'shared truth' and hence there is no need to reconcile one version of 'truth' with that of one's counterparties.
- **Enhanced cybersecurity resilience**. DLT has the potential to provide a more resilient system than traditional centralised databases and offer better protection against different types of cyber-attacks because of its distributed nature, which removes the single point of attack.

The technology is still evolving, and many regulatory and legal issues are yet to be resolved. For the time being, it is still unclear which DLT applications will actually deliver advantages over existing technological solutions and it is likely that overall gains will be incremental rather than sweeping in the medium term. The most commonly cited technological, legal and regulatory challenges related to DLT are listed below.

Technological challenges:

- **Lack of maturity.** DLT remains at an early stage of development and there are still serious concerns about the robustness and resilience of DLT, especially for large volume transactions, availability of standardised hardware and software applications, and also ample supply of skilled professionals.
- **Scalability and transaction speed.** Current iterations of permissionless distributed ledgers face issues related to scalability of blockchains, both in terms of transaction volume and speed of verifications.
- **Interoperability and integration.** Different DLT systems will need to be interoperable with other ledgers and integrated with existing systems if they are to be introduced at scale into the financial system.
- **Cybersecurity.** No software is immune from technical vulnerabilities.
- **Governance.** The absence of a centralised infrastructure and a central entity leads to concerns about ensuring effective governance of the overall infrastructure.

Legal and regulatory challenges:

- **Regulatory vetting and industry standards.** Regulatory vetting and development of industry standards are necessary, but are still in very early development phases. Malta, a small-island state, is taking a pioneering approach by offering technology certification through a new regulator.
- **Legal clarity over ownership and jurisdiction.** In payment and settlement systems, there are specific concerns related to how the 'point of finality' of a transaction would be defined in a DL environment. In addition, there are concerns about cross-border DL systems in terms of the jurisdiction of the underlying data and transactions. Regulating open, permissionless distributed ledger systems is particularly complicated, as no legal entity is in control of the distributed ledger. Regulation of private, permissioned ledgers is comparatively more straightforward, as there is usually an administrator or owner of the system that can be subject to regulation or existing regulatory frameworks for outsourcing arrangements could be used.
- **KYC and CDD.** For adoption in the financial system, DLT systems will need to comply with know-your-customer (KYC) and customer due diligence (CDD) requirements in anti-money laundering/combating the financing of terrorism (AML/CFT) regulations. Most permissionless DLT systems disguise the identity of network members by using public key encryption, which will make it difficult to comply with existing AML/CFT regulations and would allow transactions with un-vetted parties.
- **Recourse mechanisms.** As a defining characteristic of distributed ledgers is immutability, there are concerns about how transaction disputes will be resolved, in particular how erroneous transactions will be voided.

6.4 The role of blockchain in DRR

The Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted at the Third UN World Conference in Sendai, Japan, on 18 March 2015. The Sendai Framework is the successor instrument to the *Hyogo Framework for Action (HFA) 2005–2015: Building the Resilience of Nations and Communities to Disasters*. The Sendai Framework is based around four main priorities of action, as shown in Table 6.1.

The document is also guided by a number of principles that are highly tuned to the principles and characteristics of blockchain technology. The principles adopted by the Sendai Framework include shared responsibility, increased accountability,

Table 6.1 Priority areas of the Sendai Framework

Priority	Description
Understanding disaster risk	Disaster risk management needs to be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment.
Strengthening disaster risk governance to manage disaster risk	Disaster risk governance at the national, regional and global levels is vital to the management of disaster risk reduction in all sectors and ensuring the coherence of national and local frameworks of laws, regulations and public policies that, by defining roles and responsibilities, guide, encourage and incentivise the public and private sectors to take action and address disaster risk.
Investing in disaster risk reduction for resilience	Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment. These can be drivers of innovation, growth and job creation. Such measures are cost-effective and instrumental to save lives, prevent and reduce losses, and ensure effective recovery and rehabilitation.
Enhancing disaster preparedness for effective response, and to «Build Back Better» in recovery, rehabilitation and reconstruction	Experience indicates that disaster preparedness needs to be strengthened for more effective response and to ensure capacities are in place for effective recovery. Disasters have also demonstrated that the recovery, rehabilitation and reconstruction phase, which needs to be prepared ahead of the disaster, is an opportunity to «Build Back Better» through integrating disaster risk reduction measures. Women and persons with disabilities should publicly lead and promote gender-equitable and universally accessible approaches during the response and reconstruction phases.

Source: United Nations (2015).

engagement and inclusivity. These are in themselves key principles behind blockchain technology and that is why it is believed that blockchain can also contribute to disaster risk reduction and resilience building.

In fact, blockchain – together with new technologies that constitute the advent of the Fourth Industrial Revolution such as the Internet of Things (IoT) – can bring various possibilities of enhancing disaster resilience, as Table 6.2 shows. It is believed that blockchain and the interplay of various other technologies can bring about tangible solutions in five key main areas, as outlined below.

As is evident, the interplay of various technologies brings tangible improvements in a number of areas.

IoT refers to a network of physical objects embedded with sensors and software that collect data and communicate with one another. As it relates to emergency management, IoT can be used to enhance data collection from the physical environment and quickly communicate this data to different city departments.

Weather-related disasters such as hurricanes or floods sometimes prevent emergency response teams from reaching certain locations. This obstruction reduces a team's ability to track damage, notify the public with up-to-date information and respond in a timely manner. However, if IoT devices were present in these areas, they would be able to more easily broadcast signals and communicate critical data such as temperature, water quality or smoke. With this data, the government can make more informed decision on how to deploy resources during a disaster situation. Today, the Rio de Janeiro City Hall Operations Centre uses sensors to collect real-time data about weather, traffic, police, and medical services in the city.[1] In the United States, the city of Houston worked with AT&T after Hurricane Harvey to deploy IoT technology for identifying damage and communicating information.[2]

Table 6.2 Possible applications of blockchain in disaster management

Key area	Initiatives
Prediction and forecasting of weather	• Extreme weather impact analysis • Ledger to identify and verify weather data
Early-warning systems	• Enhanced real-time monitoring of natural hazards • Decentralised weather sensors generating verified and automated alerts
Resilience planning	• Enhanced emergency disaster response
Resilient infrastructure	• With smart grids and decentralised electricity networks, there can be rerouting of power to prevent blackouts • Decentralised mini-grids to improve disaster resilience
Financial instruments	• Disaster recovery funding • Decentralised and automatic execution of disaster insurance platforms • Management and enhanced transparency in the disbursement of funding aid • Routes for infrastructure investment

From a more proactive standpoint, cities can place IoT devices on city infrastructure to monitor risk factors and surface data about potential emergencies. For example, the Lower Colorado River Authority (LCRA) uses 270 sensors to measure how fast water is moving across a stream and models what water may do at different touch points.[3] From this, LCRA can proactively manage floods and easily get ahead of water-related disasters in the area.

The benefit of blockchain in emergency management, meanwhile, is that it provides interoperability and transparency. Regarding interoperability, blockchain can be adopted as a universal system across organisations – similar to the internet – and allow multiple parties across that system to co-ordinate resources in an emergency. In a disaster relief scenario, multiple parties are often contributing resources to aid an affected area. If all parties involved in this scenario were to adopt a blockchain-based shared system of record, they could co-ordinate more efficient disaster responses, ensuring resources were allocated to the areas where they are needed most.

In terms of transparency in the disaster relief scenario, blockchain could provide an immutable record, accessible by everyone, to illustrate what resources have been dedicated to an area and by whom. This transparent record, to which anyone could submit an entry, would reduce the possibility of resource diversion and corruption in these types of scenarios.

Disaster relief and aid spending have increasingly come under scrutiny in recent years, as stories have emerged where aid payments were not received by the intended recipients and were instead 'lost along the way'. These incidents, of course, call for further layers of checks and balances to a system that is already burdened with a lot of bureaucracy and red tape. However, by building a disaster relief and aid spending system on top of blockchain technology, much of the bureaucracy and red tape can be reduced, while at the same time the level of transparency, speed and efficiency would increase substantially. Using the blockchain, all aid payments could be processed in a very fast and efficient manner and, above all, this allows the tracking of payments to the intended recipient in a transparent manner.

To test the use of the distributed ledger technology for humanitarian aid payments, the Start Fund, a UK-based rapid response operation run by 42 aid agencies within the Start Network, launched a pilot programme in 2016. The programme saw co-operation with the blockchain start-up ConsenSys to allow the network's non-governmental organisation (NGO) members to gain faster access to aid payments to respond to crises. Built on top of the Ethereum blockchain, the pilot enabled for transparent and efficient transfer of funds and also for the use of smart contract applications.

Since the launch of the Start Fund in 2014, it has been activated 90 times and has reached more than five million people in 49 countries. Through the use of blockchain and smart contracts, the organisation has managed to significantly reduce standard response times. For example, the UN's central emergency response funds currently take an average of 90 days to reach on-the-ground NGOs, while the Start Fund is able to disburse funds within 72 hours of being alerted – making it the fastest emergency response fund in the world. The below case study illustrates the speed at which aid can be approved and granted. Given that everything is on the blockchain, there is an added layer of transparency and auditability in the disbursement of funds.

Case study: Response to flooding in Sri Lanka

During 13 to 15 November 2015, a depression system formed in the Northern and Eastern provinces of Sri Lanka, bringing heavy rainfall and triggering floods that affected more than 15,000 families in the Jaffna, Kilinochchi and Mulaitivu districts. This event was cause for concern, given that it took place prior to the start of the annual Northeast Monsoon season, which was forecasted by Sri Lanka's Department of Meteorology to receive 10 per cent higher-than-average rainfall. Additionally, major reservoirs had filled much earlier than in previous years, and trends were similar to the previous year, which had recorded one of the worst flood disasters in Sri Lanka.

On 18 November 2015, three agencies alerted the Start Fund, noting the limited funds and capabilities of the District Disaster Management Units, that vulnerable groups were left out of blanket distributions in evacuation centres, and that an anticipatory activation would ensure a more inclusive response. On 27 November, 8 days and 19.75 hours after the Start Fund alert, £105,915 was awarded to Handicap and Oxfam (a consortium project) and World Vision, which focused on addressing needs related to protection (awareness raising on disaster mitigation) and waster, sanitation and hygiene (pre-positioning and distribution of hygiene and shelter kits). This project reached 6,722 people with the total funding.

6.5 Opportunities for the Commonwealth

Blockchain and the emerging technologies that are powering the Fourth Industrial Revolution can usher in a new era of disaster resilience and recovery. Whereas a large proportion of Commonwealth member countries are in fact vulnerable to such disasters, some have been trail-blazers in building resilience in a number of areas and in their adoption of blockchain.

Blockchain is a transformational technology and has the ability to not only disrupt economic sectors and service lines but, more importantly, to usher in new economic systems and institutional design. It can also be seen as a disruptive force to improve government functions and public service administration.

Small island states face particular challenges in establishing an effective civil service. The literature on governance in small states focuses on the challenges that scale imposes on these states. Sutton (2006) identifies four characteristics relating to the performance of the public service:

1. **Exaggerated personalism**. Usually the public service is strongly influenced by ministers and senior public officials and may therefore be open to personal favours and patronage.
2. **Limited resources**. As a result of limited resources in small states, civil servants have to 'wear many hats', leading to inappropriate training and specialisation.

3. **Inadequate service delivery.** This occurs as a result of the cost indivisibilities that are associated with small size.
4. **Relatively high degree of dependence on foreign consultants**. A reliance on foreign management consultants often leads to these consultants promoting and applying 'scale-insensitive' management practices.

6.5.1 Blockchain in the public sector

Governments around the world are rapidly expanding their exploration and use of blockchains for a variety of uses. Just about every area of the public sector could benefit from blockchains in some way (ACT-IAC 2017). In future, centralised authorities could become less relevant in the context of blockchain technologies or their role could shift to providing a platform and governance for decentralised services, rather than being at the centre of every transaction. In reviewing global trends and research, a number of blockchain technology use-cases have emerged that governments are most actively exploring and, in some cases, actively implementing.

Identity

Blockchains could be used to establish digital identities for citizens, residents, businesses and other government affiliates. In addition to using blockchain technology to manage identity, multiple aspects of the identity could be managed using blockchain technology. For example, birth certificates, marriage licenses, passport and visa information, and death records could be managed via blockchains (ibid).

Personal records

Beyond those mentioned under identity, other personal records may be managed with blockchains. Health records, for example, could be made accessible and interoperable to all hospitals in a network or in a country. Governments will need to strongly consider patient privacy rights in such an application, such as ensuring patient authorisation is given in advance and that, ultimately, they own and control their own data. Within government, payroll systems could be built using blockchain technologies, where employees could input their time and be paid automatically through smart contracts (ibid). In Malta, educational certificates are published on the blockchain.

Financial services and banking

Blockchain technology can be used by governments to ease the overhead and burden associated with transferring funds among parties (e.g., facilitating inter-bank and international payments). In addition, some countries' central banks are experimenting with their own digital currencies built upon blockchain platforms. The Eastern Caribbean Central Bank (ECCB) is working on a blockchain-issued Central Bank Digital Currency (CBDC) pilot within the Eastern Caribbean Currency Union (ECCU). This ECCB CBDC pilot is the first of its kind and will involve a securely minted and issued digital version of the EC dollar (DXCD). The digital EC dollar will be distributed and used by licensed financial institutions and non-bank financial institutions in the ECCU. The DXCD will be used for financial transactions between consumers and merchants, including peer-to-peer transactions, all using smart devices.

Land title registry

Land title registry is a natural fit for blockchain technology. Land titles and other records related to ownership could be chronologically recorded on a blockchain ledger, along with any details relevant to a sale of property. As blockchain transactions are immutable, a full historical record of a property or other asset could be reviewed through previous records in a blockchain. This could minimise the need for expensive and time-consuming third-party involvement for transactions (ibid).

Supply chain management, asset tracking and inventorying

Similar in principle to land title registry, having a comprehensive historical record of an asset is the essential purpose of supply chain management and asset tracking. Blockchain transactions can be used as a means of documenting every transfer of an asset from its origin. Governments could track an asset from its creation, through potentially multiple stages of transportation, and eventually through purchase and even managing asset inventory. This gives anyone with permission the ability to view the chain of custody (e.g., government officials, the public) and thus enables trust in the asset (Yaga et al. 2018) Potential examples include tracking food, medicines, natural resources such as diamonds, and many other assets from origin to distribution.

Benefits, entitlements and aid

The benefits, entitlements aid processes of today often involve a significant amount of overhead and checks for compliance. Government programmes such as social security and pension payments, medical care benefits, and domestic and international aid could benefit tremendously from blockchains. For example, as mentioned above, smart contracts could be used to automate processes for eligibility verification and disbursement of funds, such as distribution of funds for those affected by a major natural disaster.

Contract and vendor management

In permissioned ledgers, perfect transparency can be given to systems and transactions while only authorised users are able to record transactions. This enables the potential for blockchain technology to be leveraged as a tool for transparency and accountability in government spending, which is often executed through contracts. Things such as tracking and paying vendors, managing purchase commitments and transactions, and monitoring schedule performance could all be done in a way that is accessible to all relevant players, as well as the public, as appropriate. In addition to the transparency and accountability angle, blockchains can make government contracting more efficient by eliminating a significant amount of overhead and automating processes that lend themselves to the workflows of smart contracts.

Energy utilities

Public energy utilities may benefit from blockchain technologies for managing of smart energy grids. Blockchains allow for the 'recording of autonomous, machine-to-machine transactions regarding electricity use' (Yaga et al. 2018.). Blockchains could also be used to manage and track contributions from different power plants into a smart grid to ensure each power generator is credited appropriately for their contribution (ibid).

Voting

Blockchain technologies have the potential to enable new methods of voting by transforming what often remains a paper-based process in countries or an electronic process with limited validation and auditability capacities. This can enhance convenience and confidence on the part of citizens. By ensuring that individual votes are eligible and counted correctly, use of blockchains also has the potential to help prevent voting challenges such as ballot rigging, which still persist in many countries. These challenges, if not overcome, can result in a lack of trust in democratic processes and can enable election results that do not reflect the wishes of the public (Foroglou and Tsilidou 2015).

Mitigating and identifying fraud

Through verifications of things such as land ownership, other assets and identities, blockchain technologies can assist governments in mitigating the risk of fraud, as well as identifying fraudulent transactions that do manage to get through. One major example of this would be for assessing and collecting tax payments.

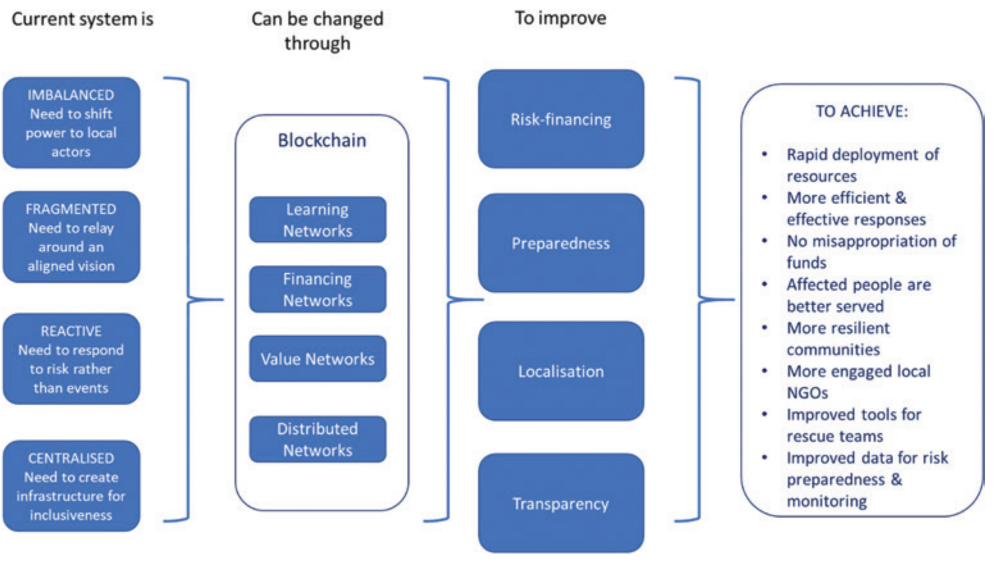
Small islands present some unique challenges in this regard, especially those linked to scale and resources. Therefore, a central and independent organisation like the Commonwealth Secretariat can play a pivotal role in supporting blockchain technology adoption by small island states. There can be collaboration between small island states which are in the process of adopting blockchain, like Malta. This can serve as a launchpad for broader adoption by other small states.

6.5.2 Blockchain for disaster risk reduction: An opportunity

In the previous section, the author presented some use-cases of blockchain in the public sector. One area which was mentioned was aid; however, this can be extended within the whole lifecycle of natural disaster management. The Commonwealth Secretariat can play a key global role in mitigating these risks and bringing about a new approach to dealing with vulnerability and building resilience. The world needs a humanitarian system that is more inclusive, diverse and dispersed. Rather than concentrating resources and decision-making – creating bottlenecks and inhibiting reform – we need to create an ecosystem of interconnections and interactions that is devolved, flexible and resilient.

The author of this chapter believes that blockchain has the power of being an inclusive network which will bring about revolutionary changes, no less in resilience

Figure 6.1 The use of blockchain in building disaster risk reduction resilience



and specifically in disaster management. Whereas blockchain is an enabler, it requires strong leadership and the Commonwealth Secretariat is well placed for this at this current juncture. In order to bring about key changes in the sector and enable countries to embrace blockchain technology, it is being proposed here that the Secretariat should be a catalyst for small states to build resilience in this area – as shown in Figure 6.1.

No single agency can bring about this change, but by collaborating on a global scale and through its values of engagement and inclusiveness, the Commonwealth Secretariat can act as a true catalyst. The author believes that the following key principles should be high on the Secretariat's agenda for disaster risk reduction.

Distributed networks

Right now, the humanitarian system is highly centralised, inflexible and resistant to change. Power and decision-making are concentrated and humanitarian responses are not defined by those closest to crises. We need to move away from this model, to one that generates solutions that are locally appropriate, independently governed and globally connected in a way that fosters efficiency, innovation and shared learning.

The Commonwealth Secretariat, together with member governments and civil society, should create a global network of national and regional hubs which are all connected on the blockchain. The network would enable power, resources and innovation to be centred closer to crisis-affected communities. This is expected to lead to the provision of better, faster and more predictable responses. All hubs would be interconnected to ensure resources and value can be shared. The Secretariat should prioritise establishing hubs in countries which are more vulnerable to disasters. The network would also serve as a means to transfer of knowledge on how to respond to such crises.

Financing networks

Despite improvements in our ability to predict disasters, the humanitarian system continues to react as though they are unexpected surprises, responding only after they occur and then often slowly. Despite research suggesting that early intervention is more effective than allowing a situation to escalate, organisations remain constrained by entrenched historical funding mechanisms.

We need new funding instruments that will enable humanitarians to mobilise more collaboratively, more predictably and in anticipation of, rather than response to, crises. New financing models should be based on three main criteria:

1. using science and data to model and quantify risks in the areas in which funds operate;
2. encouraging the pre-planning and costing of different crisis response activities; and
3. pre-positioning funds according to pre-agreed triggers, so that when the conditions are met, funding is rapidly released.

Crisis modelling and prediction would enable a more structured, rules-based approach and build certainty into financing.

Value networks

The network would be facilitated by a global platform. The platform's value will lie not in delivering programmes, but in its ability to introduce network-wide solutions, to reduce duplication and to enable all parts of the network to share and learn from one another. Participants will benefit from a 'network effect', as the platform fosters exchanges between its members. Participating in the network means reaching a greater range of users; this will help in reducing duplication and concurrently disseminating knowledge and best practice more widely.

Inclusive networks

To bring a greater diversity into the humanitarian system, for finances to flow efficiently through the network, and smaller organisations to access funds directly, we need to find ways to break down the barriers created by the current system of due diligence. Due diligence – the vetting of organisations due to receive funding – is vital for donors: it gives them reassurance that the organisations they fund have the governance and financial systems necessary to minimise the risk of misuse of funds. However, the cost of vetting, and the stringent requirements demanded by funders, result in the exclusion of many smaller organisations as potential fund recipients.

Organisations often need to be quite large to have the systems and financial accountability necessary to underwrite financial risks. This creates significant barriers to entry and reduces the possibility of inclusiveness in financing as a result of the need for due diligence requirements. In addition, donors and NGOs all have their own vetting systems, creating unnecessary duplication and administrative cost for every actor and donor in the aid system. We need to address both the inefficiency and the stifling of smaller-scale organisations that are inherent in current due diligence practices.

The blockchain and the use of artificial intelligence allows the use of global due diligence databases to provide:

- a standardised due diligence process that is tiered (not simply pass or fail) and can be tailored to context;
- online verification and validation of organisations; and
- opt-in capacity building and training to enable actors to move up the due diligence tiers.

At the heart of this initiative is to find a faster, cheaper and more effective due diligence solution which could take many forms.

Learning networks

Feedback and learning would take centre stage at every level of the proposed global network – within each programme and each hub. Learning will be decentralised: learning loops will be embedded across the global network – in each hub and every project – and all parts of the network will be equipped to develop their understanding and performance based on the feedback they receive. The network will ensure that the people delivering the programmes are those best positioned to understand the context and complexity of the work. Instead of top-down control, these teams will be guided using learning loops. The network will need an enabling framework to keep teams aligned while allowing them independence. We believe that three main thrusts of learning will be critical to the success of the project and to building resilience:

1. Demonstrating accountability – communicating outputs and outcomes to illustrate the performance of programmes
2. Building knowledge – accumulating evidence and insights over time so that future work can be stronger
3. Adapting to change – staying alert and flexible, pivoting and correcting course as changing circumstances demand

From the above, it is evident that blockchain technology has the potential of being a key enabler of change in the area of disaster management. This chapter has only looked at one potential use with multiple benefits; however, as Table 6.2 shows, there are many more areas in which blockchain can really make a difference. We believe that at the national level, countries need to implement blockchain to revolutionise public service delivery and build country resilience. However, we also believe that the Commonwealth Secretariat should take a leadership role and, by utilising the experience of its member states such as Malta, it should build a 'Commonwealth of Blockchain Islands'. The use-case for disaster risk reduction can be one of the first projects of such a network whereby small-states will learn and share best-practices in the adoption of blockchain.

6.6 Conclusion

Polities and the policy-making agenda are becoming ever more complex. The interconnectedness brought about by globalisation has amplified common challenges. However, there remains wide disparities between the coping ability of countries and resilience-building strategies become central.

Small countries remain inherently vulnerable and exposed to external shocks, yet most have not yet managed to build up their resilience. Their exposure and vulnerability to natural shocks and disasters has cost thousands of lives and decades of lost economic growth and resilience building.

The opportunity for blockchain-enabled innovation to benefit humankind and our environment is substantial, but the technology itself is still at a relatively early stage, with many hurdles to overcome. Far from being an obstacle, this presents an important opportunity for stakeholders to collectively ensure the future development of blockchain technology and its application. As argued in this chapter, blockchain can be expected to play an important role in enabling new technological solutions to pressing environmental challenges, including disaster management, but can also be extended to climate change, biodiversity, ocean health, water management, air pollution, resilience and waste reduction.

Harnessing blockchain technologies to drive sustainable and resilient growth and a new wave of value creation will require decisive action. The opportunities that blockchain offers need to be developed and governed wisely and that is why the chapter has argued that the Commonwealth Secretariat should take global leadership in harnessing blockchain between its member states and as a use-case to implement this revolutionary technology to achieve the Sendai goals.

Given the vulnerabilities and the need for resilience in this area, this chapter has argued for the creation of a Commonwealth of Blockchain Islands to use blockchain technology as an enabler for resilience.

Notes

1 See: https://10innovations.alumniportal.com/internet-of-things/iot-in-disaster-management-saving-lives-with-early-warning.html
2 See: https://www.iotforall.com/iot-natural-disaster/
3 See: https://gcn.com/articles/2017/09/20/iot-flood-sensors.aspx

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