

Blockchain innovations and the contribution of the intergovernmental organizations

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Abstract

Purpose – The United Nations (UN) is globally acknowledged for its unique role as a convening platform to address humanitarian, peace, security and sustainable development challenges. However, it is not often associated with technological innovation. Blockchain technology, an innovation that emerged in the late 2000s, has generated animated discussions that are led, in the most part, by private sector institutions. A dearth of literature highlights the innovative blockchain projects supported by UN entities. The purpose of this study is to provide an overview of blockchain innovations supported by UN entities and explore opportunities for future studies.

Design/methodology/approach – This paper used an exploratory case study approach with the purpose of providing a broad perspective of blockchain innovations undertaken by UN entities in the quest to meet sustainable and equitable development across the world.

Findings – This study found 25 blockchain projects by 13 UN entities in 19 countries. The geographical spread of the case studies revealed that two studies have global jurisdiction, five studies in Africa, three in Europe, four in Latin America and the Caribbean and 11 in Asia, Oceania and the Middle East. Of the 19 countries, three had two projects each. Two countries had three projects and the rest had one project each. Of the 13 UN entities, three dominated with UNICEF (part of six projects), UNDP (part of 10 projects) and WFP (part of four projects). Finally, the 25 projects were divided among three categories of blockchain use cases, as defined by UN guidance documents. Five case studies focused on immutable record keeping, five on transfer of value and 15 on smart contracts.

Originality/value – This study offers a unique overview of blockchain efforts within UN entities. It provides a platform for future studies to reveal implicit assumptions, contrasting explanations and casual connections.

Keywords United Nations, Record keeping, Smart contracts, Blockchain projects, Intergovernmental organizations, Land registry

Paper type General review

1. Introduction

For at least four decades, technological innovations have served as precursors to what is known as blockchain technology. Blockchain is reputed to have been borne with the



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publishing of a 2008 article on bitcoin and the 2009 launch of an open-source bitcoin cryptocurrency system by an anonymous technologist and author(s) (ISACA, 2020). Its definitions are as diverse as the variety of technology experts (Andolfatto, 2018). For this reason, this article will use consensus-based descriptions and definitions from professional associations, such as the Information Systems Audit and Control Association (ISACA), or international best practice institutions, such as the International Organization for Standardization (ISO). According to ISACA (2020, p. 13), a blockchain is a:

[...] shared transactions ledger that can be accessed by and among multiple parties, using cryptography and peer-to-peer technology to secure data into blocks and store them in an immutable chain of transactions, without any trusted central authority.

The technology innovations that contribute to what is considered within the framework of blockchain were invented at different times. For instance, public and private key infrastructures date to the 1970s, while cryptographic techniques date back more than half a century (Ratzan, 2004; Sherman *et al.*, 2019).

According to ISO 22739, blockchain technology is based on distributed ledger technology (DLT). A ledger is an information store that keeps records of any transaction “that is shared across a set of DLT nodes and synchronized between the DLT nodes using a consensus mechanism” (ISO2020 Sec 3.22). These records are “intended to be final, definitive, and immutable” (ISO2020 Sec 3.44). A blockchain functions to accomplish the sharing and distribution of data or value without the need for a trusted intermediary or enforced system management (ISACA, 2020). Participants trust the accuracy and veracity of the information on the blockchain due to the design of the software and network processes. The technology is:

- *Anonymous (or pseudonymous)*: Private information (for a public blockchain) associated with transactions that is linked to wallet addresses and public keys. In addition, personally identifiable information is not able to be viewed.
- *Distributed*: Component failure is minimized. Transactions are encrypted and stored on multiple nodes globally to make a more resilient system.
- *Decentralized*: There is no need to trust a central authority; therefore, there is less likelihood of a single point of failure.
- *Immutable*: Data is append-only and cannot be modified. For the most part, public blockchain transactions are tamper-proof.
- *Transparent*: The transaction history is easily audited, offering greater accuracy and consistency (ISACA, 2020).

Blockchain technology, in its current form, is almost a decade and a half old, making it a relatively recent phenomenon. Between 2008 and the mid-2010s, the most fervent interest was in innovating blockchain technology as a platform for cryptocurrency creation and trade (Pelz-Sharpe and Brooks, 2020). The mid-2010s saw blockchain innovations diversify to enterprise use in various sectors. Discussion about enterprise blockchain includes its application in managing medical records, land registry administration, automated contract management, supply chain tracking and identity verification (Dasaklis *et al.*, 2019; Katuu, 2021c; Pelz-Sharpe and Brooks, 2020). Many of these blockchain enterprise applications started in late 2018, with thousands developed, tested and piloted. However, only a few were deployed by 2020. Most of the pilots are expected to be scaled up, rolled out and mainstreamed within enterprises from 2023 (Pelz-Sharpe and Brooks, 2020).

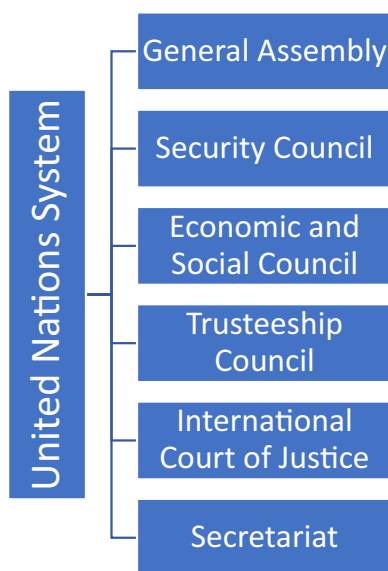
Most of the discussions related to blockchain innovation have been dominated by exploits of private sector institutions, ranging from start-ups to large conglomerates (Belchior *et al.*, 2021; Correa Tavares *et al.*, 2021). Several discussions explored aspects related to the UN sustainable development goals; however, they did not examine the contribution of UN entities directly (Coffie *et al.*, 2021; Correa Tavares *et al.*, 2021; Shin *et al.*, 2020; Tomlinson *et al.*, 2021). Two studies have suggested guiding frameworks for blockchain, with one in the development sector (Cunha *et al.*, 2021) and another in the humanitarian sector (Baharmand *et al.*, 2021). Neither of the studies would explore the work of UN entities directly.

The UN serves the unique global role of maintaining international peace and security, developing friendly relations among nations, achieving international cooperation and harmonizing the actions of nations. Considering the central role served by UN entities, it is surprising that there is a dearth of literature discussing their contribution to blockchain innovation. The few sources of literature that exist tend to have a narrow focus of either one or only a handful of case studies, often within a limited jurisdiction or supported by one UN entity. For instance, Dimitropoulos (2022) assessed effectiveness and legitimacy of the use of blockchain by the UN and the World Bank for international policymaking. Similarly, Franz (2022) conducted an analysis on the work of four UN entities using policy document assessment. Neither of the assessments examined blockchain innovations beyond policy-level analysis, which leads one to conclude that few discussions evaluate the impact of UN entity-led blockchain projects (Kshetri and Voas, 2018). Due to this research gap, the current article used an exploratory case study approach with the primary purpose of providing a broad perspective of blockchain innovations undertaken by UN entities in the quest to meet sustainable and equitable development across the world.

2. UN system and blockchain case studies

Before exploring blockchain case studies supported by UN entities, it is necessary to have an overview of the administrative context of the entities. The UN is probably the world's most recognized intergovernmental organization, an entity created by two or more nations through a treaty to work on issues of common interest while retaining a legal personality separate from the nations (Hofman, 2020; Katuu and Kastenhofer, 2020; Volgy *et al.*, 2008). The UN system is not just one institution. Instead, it constitutes a large network of entities that are connected and coordinated by six principal organs, as illustrated in Figure 1 (United Nations, 2021b).

There are more than 200 UN entities that span the six principal organs illustrated in Figure 1. Their impact has been perceived in different ways. Symbolically, UN entities' work and influence exist in reports on the state of human rights, the sciences, biodiversity, cultural heritage, communication and education, as well as through declarations, recommendations and conventions (Boel and Sengsavang, 2020). However, their impact may also be felt through their physical presence on the ground, in field stations, where they conduct peacekeeping, work with displaced persons, support health systems or through development activities (Franz, 2022; Katuu, 2021a). In addition to this conventional work, several UN entities are actively engaged in blockchain projects. Sirimanne and Freire (2021), both staff members at the United Nations Conference on Trade and Development, argued that blockchain provides a new technological paradigm that could transform social interaction, public institutions and the world's relationship with the environment, as well as affect countries' options for pursuing sustainable development. These blockchain projects, among UN entities, have taken place within the larger rubric of transformational initiatives spearheaded by the UN secretary general. These include:



Source: United Nations – Department of Global Communications (2021)

Figure 1.
United Nations
system

- A roadmap for digital cooperation, including recommendations on digital economy, human and institutional capacity, digital human rights, digital trust and security (United Nations, 2020b).
- A strategy for data-driven transformation that defines outcomes, explains enablers and capabilities, and provides a six-step data action framework (United Nations, 2020a).

The UN supported blockchain projects provide innovative opportunities for cash and remittance transfers, supply chain tracking, record keeping, digital identity, increasing transparency and many others (United Nations Innovation Network, 2021). There are varied ways of categorizing the blockchain use cases (Belchior *et al.*, 2021; Sonmez *et al.*, 2021). According to the macro-level classification developed by the UN Innovation Network, there are three primary use cases:

- (1) record keeping;
- (2) transfer of value; and
- (3) automated logic.

These increase from the most basic application to the most complex (United Nations Innovation Network, 2020b):

- *Immutable record keeping:* As the most fundamental function, the blockchain “serves as an immutable ledger, meaning that once information has been verified and committed to the system, it cannot be edited or deleted – creating a permanent record. Because of the construct of blockchains, different parties can access the

same information seamlessly, breaking down data silos that often plague organisations – particularly those with multiple agencies, partners, vendors, etc.” (United Nations Innovation Network, 2020b, p. 4).

- *Transfer of value*: This use case leverages “the ledger of blockchain to record the transfer of an asset. By utilising blockchain, third-party processors and clearinghouses play a lesser role, reducing transaction costs and the time delay that typically occurs when moving value between parties” (United Nations Innovation Network, 2020b).
- *Smart contracts*: In this use case, blockchains automate logic. It can be used in the context of an organization that is streamlining and expediting its administrative processes. “Smart contracts use an information source, called an oracle, to determine if conditions have been triggered, and as a result, generate a new transaction which is added to the ledger” (United Nations Innovation Network, 2020b, p. 5). Despite the name, smart contracts are not legally binding; therefore, doing so usually requires traditional paperwork to accompany the digitized rules (Hofman, 2017).

There is no suggestion that these categories are mutually exclusive; however, they may provide ways to disaggregate value propositions for different use cases. It is also likely that a project may fall in more than just one use-case category.

3. Research approach

As noted in the introductory section, blockchain technology is just over a decade old and is, therefore, still in its formative stages. A systematic investigation of the subject should be cognizant of, among other things, its context, how and where innovations are taking place, and the experiences of actors within the phenomena. For this reason, such an investigation is best undertaken as a case study (Darke and Shanks, 2002) because they are appropriate when a contemporary phenomenon, such as blockchain technology, is to be studied within a context where research and theoretical understanding is still in its nascent stages (Benbasat *et al.*, 1987; Patnaik and Pandey, 2019).

There are several flavors or categories of case study research, including explanatory, exploratory and descriptive case studies (Yin, 2009). Explanatory studies seek to establish a cause-and-effect relationship. Descriptive studies attempt to present a comprehensive representation of a phenomenon within its context. In contrast, the primary purpose of exploratory studies is to extend an understanding of a phenomenon and provide a basis for future studies, for instance, by defining initial questions that form foundational understanding (Ogawa and Malen, 1991; Patnaik and Pandey, 2019).

This article chose an exploratory case study approach. It examined multiple cases or projects undertaken by UN entities, enabling a broad examination of blockchain. Table 1 provides an outline of blockchain projects undertaken by several UN entities across the world. The entities are drawn from the UN Innovation Network, which has representatives from more than 70 UN entities in more than 120 countries (United Nations, 2022; United Nations Innovation Network, 2020a). Several of these entities contributed to developing the atrium blockchain platform, in which they share resources and case studies to provide an opportunity for dialogue and engagement among practitioners (United Nations Innovation Network, 2020a). In Table 1, 25 case studies are sorted alphabetically by the project name. It includes a brief description of each project, the primary use case, the UN entity or entities undertaking the project, and the country or countries where the project is being carried out.

Project name	Project description	Use case	UN entity	Country
Blockchain for land registry	UNDP built a land registry for the city of Panchkula in the Indian state of Haryana. Considering the widespread challenges in establishing and/or reconciling land ownership within cities, this was expected to be a proof of concept for other land registries in the region. The system was built so citizens who engaged in buying or selling property would neither require blockchain accounts or wallets nor experience a change in the way they normally interact with the government's land registry because the system was transparent (UNDP, 2018c)	Immutable record keeping	UNDP	India
Blockchain for pig farmers	FAO and ITU piloted a livestock tracking system with a distributed ledger that enables farmers to record important information about their pigs, including pedigrees, feed, illness and medications. The vital system established consumer trust and ensured that farmers could expand their markets and earn a fair return on investments (Food and Agricultural Organization, 2019; Food and Agricultural Organization and International Telecommunication Union, 2019)	Immutable record keeping	FAO and ITU	Papua New Guinea
Blocks for transport	WFP sought to simplify the process of signing shipping documents along the supply chain in Ethiopia and the Djibouti corridor. They used blockchain to create a more visible humanitarian supply chain and reduce transportation delays (Strömfelt, 2020)	Smart contract	WFP	Djibouti and Ethiopia
Building blocks	WFP developed the system as a means of making cash transfers more efficient, transparent and secure. The system was initially piloted in Pakistan to assist organizations in Lebanon. It was extensively used in Bangladesh and Jordan. Vulnerable communities securely access assistance to meet their essential household needs. They were also ensured that that no sensitive information (e.g. names, dates of birth or biometrics) was stored in the system (WFP, 2022)	Transfer of value	WFP	Bangladesh Lebanon and Jordan

(continued)

Table 1.
UN blockchain case studies

Table 1.

Project name	Project description	Use case	UN entity	Country
Cash-for-work	UN Women and WFP assisted Syrian refugees in refugee camps in Jordan in participating in cash-for-work programs. The refugees received monthly entitlements that were secured on a blockchain network. They accessed fiat money or made purchases through WFP-contracted supermarkets (UN Women, 2018)	Transfer of value	UN Women and WFP	Jordan
CedarCoin	UNDP explored the use of CedarCoin to promote the reforestation and protection of Lebanon's ancient cedar forests (the symbol of the country). Each tree was assigned a coin. The coins were distributed to investors and communities to host the trees. This effort encouraged reforestation and rewarded environmentally conscious behaviour (UNDP, 2019a)	Transfer of value	UNDP	Lebanon
Cocoa blockchain	UNDP used blockchain to document Ecuadorian cocoa beans from the farm to the market in Europe. This included monitoring hygiene in facilities and time stamping with pictures and videos. Food was tracked across the entire supply chain via two-dimensional (QR) codes and radio frequency identification (UNDP, 2019b)	Smart contract	UNDP	Ecuador
Cost of remittances	UNDP worked with government officials in Serbia's city of Nis to develop a digital identity system that enabled beneficiaries in the diaspora to receive direct remittance. The system would drastically reduce the cash transfer costs, as well as allow the purchase of vouchers for items like food and electricity. It was used at the point of sale or on a mobile app to pay for electricity, groceries, etc. (UNDP, 2018a)	Transfer of value	UNDP	Serbia
Cotton blockchain	UN Economic Commission for Europe (UNECE), as well as UN Centre for Trade Facilitation and Electronic Business (UNCTFEB), launched a pilot project to enhance the traceability and due diligence in the cotton value chain through the implementation of blockchain technology to support a circular economy approach. The pilot is being implemented in collaboration with experts from brands,	Smart contract	UNECE and UNCTFEB	Global

(continued)

Project name	Project description	Use case	UN entity	Country
Credit Bureau of the Future	manufacturers, raw material providers, standard-setting bodies and technology providers. It covers all the production steps of the value chain, as well as relevant business data and sustainability data elements identified in a mapping conducted by UNECE and UN/CEFACT experts (UN Economic and Social Council, 2021 ; UN Economic Commission for Europe, 2021) UNDP and UN Capital Development Fund (UNCDF) developed a national digital identification system in Sierra Leone. It will be used to modernize the credit reference bureau. This design gave the nation's seven million citizens, most of whom do not have any credit history or formal identity, access to financial services (Cheney, 2019)	Immutable record keeping	UNDP and UNCDF	Sierra Leone
Distributed renewable energy	UNDP explored blockchain-enabled solutions for the uptake of renewable energy. It initiated a pilot project to examine the first unbundled, voluntary market for renewable energy certificates (REC) for Lebanon by leveraging blockchain technology. The objective was to showcase the technical feasibility and market interest of establishing this certificate marketplace to support the energy transition in the country (UNDP, 2020)	Transfer of value	UNDP	Lebanon
goLandRegistry	UN Habitat and UN Office of Information and Communication Technology signed a memorandum of understanding to create a registry for urban informal settlements that would address access to secure land rights in Afghanistan (Fitzpatrick, 2020). The registry handled at least one million land individual parcels registered on blockchain. Occupancy certificates were issued; these could be independently verified using an open source verification tool (Polites, 2020 ; United Nations Habitat, 2020)	Immutable record keeping	UN Habitat and UN-OICT	Afghanistan
Kotani Pay	UNICEF's Venture Fund supported a start-up in Kenya that was building a solution that allows access to blockchain technology to send and receive money without the need for	Transfer of value	UNICEF	Kenya

(continued)

Table 1.

Table 1.

Project name	Project description	Use case	UN entity	Country
Leaf wallet	internet connectivity or a bank account. This is ideal for populations in developing countries that have feature phones and low-end smart phones but can use unstructured supplementary service data (USSD) (UNICEF, 2021b) UNICEF's Venture Fund supported a start-up in Rwanda that was developing a virtual bank for refugees and vulnerable populations. It allowed for the storage and transfer of assets across borders without the need of a smartphone (UNICEF, 2021c)	Transfer of value	UNICEF	Rwanda
Pension tracking	UN Joint Staff Pension Fund (UNJSPF), in conjunction with the UN Integrated Computing Centre (UNICC), introduced a certificate of entitlement (CE) that certifies the identity of the retiree beneficiary and confirms that the beneficiary is living and residing at their registered location. The solution automates and makes immutable the CE process with blockchain, biometrics and a mobile app (UN Integrated Computing Centre, 2021)	Immutable record keeping	UNJSPF and UNICC	Global
Plate by plate	UNDP set up a digital platform for food donation. Humanitarian organizations can have direct access to food information from retail shops in a transparent and traceable manner (UNDP, 2021b)	Smart contract	UNDP	Serbia
Rahat	UNICEF's Venture Fund supported a start-up in Rwanda that developed a digital cash and voucher assistance management system. The platform includes an online dashboard, digital wallet, vendor app and QR code/SMS-based token redemption process for beneficiaries (UNICEF, 2021d)	Transfer of value	UNICEF	Nepal
Remittances	UN Capital Development Fund (UNCDF) developed savings and credit products that cater to migrant Nepalis outside the country and their beneficiary families in Nepal. The project explored the blockchain's potential to facilitate cross-border settlements to drive down costs and artificial intelligence-driven credit scoring technologies to originate and gauge	Transfer of value	UNCDF	Nepal

(continued)

Project name	Project description	Use case	UN entity	Country
Solar Currency Exchange	customer creditworthiness (UN Capital Development Fund, 2018) UNDP raised awareness on how to access and promote solar energy using SolarCoin in Moldovan universities. Once all solar cells were purchased, recipient buildings began to pay their rent. They were charged for every unit of electricity generated, covering the cost of equipment, installation and maintenance up to 20 years. The owners of the solar cells receive SolarCoins based on the amount of solar energy produced (UNDP, 2018b)	Transfer of value	UNDP	Moldova
Tandas	UNICEF's Venture Fund supported a start-up in Mexico that builds a decentralized application for saving circles. This allows payments using smart contracts to automate user payments and withdrawals (UNICEF, 2021a)	Smart contract	UNICEF	Mexico
Traceability of livestock farming	UNDP built a platform to support traceability, certification and incentives across the livestock sector through a two-phase digital system. The first phase involved ranchers to the slaughterhouse. The second phase involved the slaughterhouse to the final consumer. This ensures full transparency and traceability across the entire supply chain. It also links price benefits and incentives back to cattle ranchers (UNDP, 2021a)	Transfer of value	UNDP	Ecuador
Traceability platform for smallholder farmers	In 2020, WFP launched a blockchain-based platform that tracks food product through the whole supply chain (from farm to retail shop). It helped farmers register and prove product compliance with local and international food safety standards. In addition, it allowed retailers to access and purchase certified crops (World Food Programme, 2020)	Transfer of value	WFP	Jordan
Track-and-trace for more transparent supply chains	UNDP used DLT to help women-owned cooperatives in rural communities in Morocco better market and differentiate their products via sustainability certifications with provable certification and traceability (Proofing Future, 2021)	Transfer of value	UNDP	Morocco
Treejer		Smart contract	UNICEF	Iran

(continued)

Table 1.

Table 1.

Project name	Project description	Use case	UN entity	Country
Xcapit	<p>UNICEF's Venture Fund supported a start-up in Iran that developed a protocol to connect tree funders to rural planters using decentralized finance, NFTs and smart contracts to unlock opportunities in climate finance and rural development. In the initial program, three Iranian communities in three villages were funded to plant 1,000 traceable trees (UNICEF, 2021e)</p> <p>UNICEF's Venture Fund supported a start-up in Argentina that built a platform to increase safe and easy access to financial services. This included financial planning, gamified savings and wealth management tools (UNICEF, 2021f)</p>	Transfer of value	UNICEF	Argentina

Source: [United Nations \(2021a\)](#)

4. Discussion

Typically, exploratory studies attempt to answer the “what” question (Patnaik and Pandey, 2019). In this study, the question would be: “What is the scope of blockchain studies currently undertaken by UN entities across the world?” As is common in the exploratory approach, several preliminary observations can be made from this study. First, the geographical spread shows that, of the 25 case studies, two studies have global jurisdiction, five in Africa, three in Europe, four in Latin America and the Caribbean, and the other 11 in Asia, Oceania and the Middle East. This global expanse suggests there are no limits to the environments in which blockchain technology could be deployed. That said, of the 19 countries that share the 25 projects, a few have multiple projects:

- Ecuador has two by UNDP;
- Jordan has three by WFP and one in conjunction with UN Women;
- Lebanon has three, with two by UNDP and one by WFP;
- Nepal has two, with one by UNICEF and one by UNCDF; and
- Serbia has two, both by UNDP.

Future studies should explore why a country may attract more than one project, as well as why they are often conducted by the same UN entity.

Second, Table 1 shows that 13 UN entities across the world actively support and deploy blockchain technology. However, the following three entities dominate: UNICEF with six projects; UNDP with 10 projects; and WFP with four projects. Furthermore, all three entities report to the UN General Assembly (United Nations – Department of Global Communications, 2021). One could speculate that the institutions have been afforded innovative latitude and autonomy that may not be present in institutions that report to other principal organs. However, this remains speculation. Therefore, future studies should explore the reasons that these three entities are the most innovative.

Third, the 25 case studies are mapped against the three macro-categories of use cases developed by the UN Innovation Network. Future studies should interrogate this use case categorization, arguing that they increase in sophistication from recordkeeping, transfer of value and smart case (United Nations Innovation Network, 2020b). Nonetheless, utilizing the use cases as they are, the table reveals that five case studies focus on immutable record keeping, five focus on transfer of value and 15 focus on smart contracts. This initial overview provides the opportunity to explore use case categories in groups. For instance, there are two land registry case studies in Afghanistan and India. In both cases, UN entities have collaborated with private entities in developing applications deployed in the countries to address land management as they form the basis for urban planning and economic empowerment. Table 2 breaks down the institutions, blockchain platform and information on the participating private entities.

Table 2 demonstrates that more research should explore the nature and scope of partnership between UN entities and private enterprises in developing and implementing blockchain innovations. In addition, Table 2 shows that the project in Afghanistan had two UN entities that reported to two UN system principal organs that collaborated in the project. In other words, UN-Habitat, which reports to the UN General Assembly and UN Office of Information and Communication Technology (UN-OICT), is part of the UN Secretariat (United Nations – Department of Global Communications, 2021). This is an incredible achievement considering how often autonomous UN entities are reputed to work in silos, competition and/or cross-purposes (Ghani and Lockhart, 2008; Taylor, 2003). Further research on this partnership may provide lessons on collaboration work among UN entities.

Table 2.
Land registry case
studies

Country	Afghanistan	India
Project name	goLandRegistry (LTO Network, 2020; United Nations – Office of Information and Communication Technology, 2021a)	Blockchain for land registry (Jeena, 2021; Williams, 2018)
Institution's	UN Habitat and UN-OICT (United Nations – Office of Information and Communication Technology, 2021b)	UNDP
Blockchain platform	LTO Network (United Nations – Office of Information and Communication Technology, 2020)	Ethereum (UNDP, 2018c)
Technology partner	LTO Network, founded in 2014, is headquartered in Amsterdam, The Netherlands. It is estimated to have less than 50 employees (LTO Network, 2021; Pelz-Sharpe, 2019)	Blockscale solutions, founded in 2017, is headquartered in Toronto, Canada. It is estimated to have less than 50 employees (Blockscale Solutions, 2021; Seale, 2018)

Exploratory case studies can stimulate the development of more detailed studies by inductively generating (rather than deductively confirming) insights regarding a phenomenon of interest (Ogawa and Malen, 1991). Insights, such as those made about case studies in Table 1, would be provisional in nature. They would need additional investigation, such as those tentatively explored in Table 2. In this sense, rather than provide definitive answers, these studies generate questions that need to be pursued to reveal implicit assumptions, contrasting explanations, causal connections, etc. (Ogawa and Malen, 1991; Patnaik and Pandey, 2019).

5. Conclusion

Blockchain technology, being just over a decade old, is still in its nascent stage. Over the course of a decade, blockchain projects have served as pilots, with investment activities concentrated on developing concepts, providing seed financing or launching financing (Chalmers *et al.*, 2021). Nonetheless, with the transition from pilot projects to enterprise-wide applications, the market for enterprise blockchain technology sales was projected to grow from US\$5.6bn in 2020 to US\$13.8bn in 2025 (Pelz-Sharpe and Brooks, 2020).

While discussion on the technology has featured many private and public sector institutions, the contribution of UN entities is diminutive. This article sought to provide an overview of the efforts made by various UN entities' engagement with blockchain technology innovations in support of their roles with regard to sustainable human development. To do this, the study used an exploratory case study approach, with the primary purpose of providing a broad perspective of blockchain innovations. It aimed to begin to understand the phenomenon and form a basis for future studies (Yin, 2009). In exploring the 25 projects undertaken by UN entities, this study raised several questions around the following three themes:

- Q1. Nature of the studies, including geographical spread (nation/continent) and number of projects within the jurisdictions.
- Q2. Nature of the UN entities engaged in these projects.

Q3. Use case categorization and opportunities raised for more in-depth research within each use case group.

This article has also demonstrated that UN entities are collaborating with private entities to support nations' efforts to address development challenges. During this process, there is an expectation that countries should improve their capabilities in developing and enforcing blockchain regulations while they seek to participate in international initiatives (Sirimanne and Freire, 2021).

While UN entities contribute to blockchain innovations within individual countries, there is an effort within the UN entities to transform their own internal processes. For instance, the UN's Universal Postal Union published a report on the use of blockchain in postal logistics, as well as financial inclusion (Universal Postal Union, 2022). The UN's International Telecommunication Union (ITU) and International Labour Organization (ILO) are using blockchain-based systems in some of their internal processes, including the management and verification of documents (Dumitriu, 2020). There is the potential to incorporate blockchain innovation in other internal enterprise level systems; however, this will require different sets of expertise and an enterprise approach (Dumitriu, 2020; Katuu, 2021b, 2022).

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