

Blockchain for Women Next Generation for Sustainable Development Goal 5

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Blockchain For Women highlights the potential of Blockchain, a nascent technology, in re-vamping the role of Women, Children and Gender minorities through Identity, Ownership, and Access. It discusses the gender digital divide impacting SDG 5 and how Blockchain is overcoming this problem to meet the Goals. While applying Blockchain as a technology and its beneficial attributes applicable to SDG 5, the paper engages with how Blockchain is being piloted and tested by the United Nations, civil society, corporations and startups alike in various sectors impacting women. The paper bridges the gap between the theoretical potential of Blockchain to showing actualized, on-the-ground applications of Blockchain technology in meeting SDG 5 Goals.

Keywords: Blockchain, SDG 5, United Nations, Gender Equality, Access, Time-Stamped, Immutable, Women, Trafficking, Children

Received April 1, 2018

Revised June 5, 2018

Accepted June 24, 2018

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INTRODUCTION: GENDER EQUALITY AND SDG 5

At the 66th Session of the General Assembly held in September 2011, UN Secretary-General Ban Ki-Moon, showcased the “crucial role of gender equality as ...[a]... driver of development progress, recognizing that the potential of women had not been fully realized, owing to, inter alia, persistent social, economic and political inequalities.” The World Bank (2012) states gender equality a core development objective in its own right. It states, “greater gender equality can enhance productivity, improve development outcomes for the next generation, and make institutions more representative.” For the United Nations, “gender equality is not only a fundamental human right, but a necessary foundation for a peaceful, prosperous and sustainable world.”

The Report of the Secretary-General (2017), *Progress towards the Sustainable Development Goals* states, “Achieve gender equality and empower all women and girls.” As a result, in September 2015, United Nations member states adopted the 2030 Sustainable Development Goals: 17 interrelated goals and 169 associated targets to promote social, economic and environmentally sustainable development. Even though SDG5 is a stand-alone goal, interconnectedness and linkages between SDGs are essential. The 2030 Agenda, thus, aims for synergistic progress by focusing on all the SDGs together (Colglazier, 2018). It promotes multi-stakeholder engagement, national action plans, and public-private partnerships.

Most importantly, the 2030 Agenda “strives to harness science, technology, and innovation (STI) to accelerate progress.” It has an initiative called the Technology Facilitation Mechanism (TFM), responsible for an annual multi-stakeholder Forum at the UN, focused on STI for the SDGs 5.

Consistent with SDG 5B and the gender digital divide, Blockchain, is being tested in 2017-2018 by development circles as a *means of implementation* technology (Olsen et. al, 2014) for Sustainable Development Goal 5. The 72nd Session of the United Nations General Assembly in 2017 established the Blockchain Commission for Sustainable Development. This commission will “develop a multi-sectoral framework to support the UN system—along with Member States, Intergovernmental Organizations, the private sector and civil society—in utilizing blockchain-based technologies to develop local, national and global solutions for the most pressing issues of our day.” The Decade of Women reiterated this important Blockchain Revolution and is pushing women forward in this field, where a stark gender gap exists.

This paper showcases the potential of Blockchain, a nascent technology, in empowering Women, Children and Gender minorities through Identity, Ownership, and Access. It talks about the gender digital divide impacting SDG 5 and how Blockchain is overcoming this problem to meet the Goals. Next, it discusses Blockchain as a technology and its beneficial attributes applicable to SDG 5. The bulk of this paper discusses how Blockchain is being piloted and tested by the United Nations, civil society, corporations and startups alike in various sectors impacting women. The paper bridges the gap between the theoretical potential of Blockchain to showing actualized, on-the-ground applications of Blockchain technology in meeting SDG 5 Goals.

BLOCKCHAIN FOR WOMEN: SDG 5

Sustainable Development Goal Target 5.1 end all forms of discrimination against women and girls everywhere.

Digitalization of innovation and its implications for sustainable development goals (SDGs) was a key challenge discussed at the 18th Global Development Conference on Science, Technology and Innovation for Development. It focused on knowledge systems in forging “new pathways of development with production, diffusion and adoption of innovation and technology.”

As an *assistive technology*, Blockchain promotes Women’s Empowerment Principles of the United Nations Global Compact (UNGC): greater equality for women by benefitting businesses in the workplace, marketplace, and community.

For the Blockchain Commission for Sustainable Development, building “radically decentralized solutions for a safe, fair and sustainable future” in alignment with the UN’s Sustainable Development Goals is crucial. (Blockchain Commission, 2017). Its goals are “conservation of natural resources, protection of the commons, economic growth, empowerment of all communities, financial inclusion and security, public health and welfare, civic trust and protection of the integrity of democratic systems—among others—for the benefit of our common humanity.”

In development circles, Blockchain’s potential lies from digitizing an archaic paper-based disparate system that is tamper-prone, alterable, easy to lose, spread across different parties and individuals, lacking a universal time log or recording system, to a modern digitized one-stop shop enabling trusted and verifiable records (Kamath, 2018). For women, this can be the difference between life and death.

Under the World Identity Network, Blockchain for Humanity (2018) states that Blockchain technology “provides decision-makers with reliable, well-informed, unbiased advice and assistance to conceptualize and develop progressive ID systems that are robust, secure and inclusive.” It enables public-private partnerships to achieve a universal, digital ID system, and forges a strong alliance of partners to implement ID systems on blockchain, DLT, and other open-source platforms.

Blockchain as Empowerment of Women and Reducing Gender Digital Divide

Sustainable Development Goal 5.B “Enhance the use of enabling technology, in particular, information and communications technology, to promote the empowerment of women.”

Blockchain enables ICT promotion and reduces the gender digital divide. Stafford-Smith, et al. (2017) states that in relation to SDGs, “technology link[s] across actors and countries by promoting an integrated global in-

novation system for sustainable development knowledge and for technology exchanges based on environmental, economic, and cultural affinities.” Huyer and Sikoska (2003) encapsulate ICTs as a tool for women’s empowerment. The collective empowerment of women with the use and management of information is the goal of ICT promotion (Id).

The Gender Digital Divide leads to “increased polarization and widening income inequalities, as [...] gains accrue to the wealthy and skilled few individuals.” (Bimber, 2000; UNCTAD, 2017; Herbert, 2017). Women and the poor “are not regarded as priorities for public investment; Their rights to access technologies and technical knowledge are overlooked; their potential as technology innovators is ignored; technologies are often unaffordable,” for them (Olsen et al, 2014). In “Information technology and gender equality: A contradiction in terminis,” Ingeborg and Reinen (2000) demonstrate how “females know less about information technology, enjoy using the computer less than male students, and perceive more problems with software.” Thus, overcoming the gender digital divide is a huge leap forward in empowering women and girls.

In an analogous example to Blockchain, Mijumbi (2002) illustrates the impact of CD-ROMs on women. Learning how to save money, opening new bank accounts, becoming trainers and empowering other women with similar knowledge, improved reading skills, productivity in crop yield, developing new ideas for businesses, resulted in both increased knowledge and enhanced self-esteem (Haffkin, 2002). Therefore, investing in gender equality and technology-driven initiatives for women are “smart economics” (Chant and Sweetman, 2012).

Blockchain is the next generation “enabling” technology under SDG 5.B, that is providing women with the leverage they need to be empowered in society through ICT.

ABCs of Blockchain Technology

What Is Blockchain?

Blockchain technology is a database, a ledger, a platform, a service, an asset, and it enables smart contracts transactions (Kamath, 2017). Blockchain originated from the Bitcoin-Blockchain consensus algorithm (Satoshi Nakamoto, 2008), Blockchain is a type of Distributed Ledger Technology (DLT) based on TCP-IP Internet Suite Protocols (Alkan, 2016; Roslington and Edwards, 2017), with cryptographically secure and peer-peer transactions. Blockchain is a system of interconnected nodes, where each node is an entity or individual with access to that block and thereby, the blockchain. (Kastelein, 2015).

Blockchain exists in three forms: centralized, distributed and decentralized (BlockGeeks).

As a decentralized database, Blockchain keeps a chronologically growing list (chains) of records (blocks) impervious to tampering and revision (Witte, 2016). Like modularity design architecture rules, voluntary ledger participants (nodes) determine rules for their blockchain (Clark). Therefore, each node is an “administrator” (Blockchain Revolution) of the accessed blockchain and is part of a decentralized network.

Like Wikipedia or Google Docs (Mougyar, 2016) but more secure, all participants with access to their blocks, can independently tweak data with the most popular record becoming the de-facto official record. This is despite having a master copy. As most Blockchains are deemed to be permission-less systems, end users can transact and indulge in economic interactions, independent from central authorities and without the need to know who the other party is. Reducing institutional prowess is the benefit of Blockchain’s decentralized and often permission-less nature. With consumers and end users having more power and control over their data, information and transactions.

Having gained popularity through bitcoin-crypto (Nakamoto, 2008), benefits of blockchain technology are being touted in a myriad of ways. Some characteristics are (a) Immutability, (b) Time-Stamping, (c) Single, Universal Truth, (d) Increased Security and Privacy, (e) Greater Liquidity and Faster Settlement, (f) Increased Capacity, (g) Decentralized and Distributed, (h) Advanced Computing, (i) Smart Contracts, (j) Permission-less, and (k) Shared Public Ledger (Kamath, 2017).

In the *Blockchain Revolution*, Tapscott & Tapscott (2016), “the new blockchain technology facilitates peer-to-

peer transactions without any intermediary such as a bank or governing body. Keeping the user's information anonymous, the blockchain validates and keeps a permanent public record of all transactions."

With increased trust creation, a high level of immutability, and large reductions in intermediation costs, Blockchain is impacting value chain management (IBM, 2016), various services of the sharing economy, improved government services such as identity management and humanitarian aid (Tapscott & Tapscott, 2016).

Adding to this is *authorization*, ranging from having enough money to broadcasting the correct transaction type. All this needs a distributed, peer-to-peer network as a starting point. Authorizing transactions is a result of the entire network applying the rules upon which it was designed (Blockchain's protocol) to facilitate smoother transactions in the digital world (Bauerle, 2017). A key feature of Blockchain, pervasive throughout its implementation, is private key cryptography - a powerful ownership tool that fulfills authentication and authorization requirements. It minimizes the need for over-sharing of personal information, making them less vulnerable to hackers and reduces exposure to others.

Mining, Hashing, Nonce: Blockchain incorporates three concepts: mining, hashing, and nonce. (Jordi et al, 2017). A key feature of Blockchain, pervasive throughout its implementation, is private key cryptography - a powerful ownership tool that fulfills authentication and authorization requirements (Id.). It minimizes the need for over-sharing of personal information, making them less vulnerable to hackers and reduces exposure to others.

- **Mining:** Mining is the process for a decentralized clearinghouse through which transactions are validated and cleared. It secures the system against fraudulent transactions or transactions- double spend- spending the same amount of bitcoin more than once. Miners provide processing power to the bitcoin network in exchange for the opportunity to be rewarded bitcoin by solving a cryptographic hash algorithm, known as proof of concept (Scott). By authorizing these new blocks and recording them on the global ledger, these "confirmed" transactions become part of the Block, thereby, allowing new owners to spend the bitcoin they received in those transactions.

- **Hashing:** Signatures are a fundamental part of blockchains. Like signing a check, cryptographic signatures determine which transactions are valid. To chain and identify blocks, Blockchain uses a Hash: a cryptographic signature (Acheson). So, blocks in a blockchain are identified by their hash, serving the dual purpose of identification and integrity verification. A few examples of hashing are: (a) addresses on a blockchain are derived by a process of hashing public keys, (b) an Ethereum account is computed by hashing a public key with Keccak-256 (developers should read the crucial distinction with SHA3-256), and (c) A Bitcoin address is computed by hashing a public key with SHA2-256 and RIPEMD160. Collision resistance of hash functions are important because if two people generate the same address (a collision), then either could spend the money sent to that address. Transaction hashes are highly visible in a blockchain. Instead of describing a transaction as "the transaction where Alice sent Bob X units of currency at date D and time T," transactions are referred to by their hash. For example, 5c504ed432cb51138bcf09aa5e8a410dd4a1e204ef84bfed1be16dfba1b22060 is a transaction in the Ethereum blockchain. To see a complete detailed list of transactions, one must copy the hash, and paste it into a blockchain explorer.

- **Nonce:** For blockchains that use mining, Proof-of-Work is a number, called a nonce, that when combined with other data and hashed, produces a value smaller than a specified target (O'Reilly). When a valid nonce is found, verifying it is done within a second, and then the new block propagates across the network, forming the latest consensus and blockchain. Since storage in blockchains is permanent, and storing copious amounts of data on a blockchain is not economical, the practical way to store data on a blockchain is to store a fixed (and normally smaller) size representation of the data called the "hash of the data" (Folpmers and Olijve, 2016). Secure cryptographic hash functions are one-way, fast to compute, and collision resistant (*Beyond the Hashcash Proof-of-Work*; Brownworth). Combined with the property that they process any type of input to produce an output of fixed-size, called a hash, hashes are very useful as an identifier for any data. Hashes of length 256 bits represent an astronomical number of combinations, that they are more than enough to be a globally unique identifier for the Internet of Things, even at the scale of nanotechnology and beyond.

The applied principles of blockchain are through smart contracts (self-executing contracts automated on a real-time basis), tracing methodology (recording and time stamping a log on the blockchain), and tokenization and crypto (building blocks of information with layered information that is changeable by a peer to peer network on the distributed ledger). Decentralized Applications (DApps) are presenting and curating information in wholly new ways, creating a broader audience for a woman's story and plea. Blockchains also exist in a private, centralized fashion which allows for trusted parties to work securely in a trusted environment. Blockchain technology is, thus, described as "the backbone for a transaction layer for the Internet, the foundation of the Internet of Value." (Bauerle, N., 2017).

This paper demonstrates what Blockchain is doing to amplify women by extending positive externalities in P2P and P2B cross-border networks (Olsen et. al, 2014). To the best of this researcher's knowledge, there has not been a scholarly paper written on blockchain from a development perspective, nor empirical, quantifiable studies carried out. Rightly so, because this is a novel technology that has only been piloted and tested as late as 2016. By showcasing the various blockchain pilots and case studies and its potential application to development projects, this paper takes development literature of SDG 5 to blockchain, the next generation of revolutionary technologies and development methods.

BLOCKCHAIN AND SDG5: NEXT GENERATION OF GENDER DEVELOPMENT PROJECTS

Blockchain Identity: Greater Digital Personhood & Existence

In her opening remarks, Atefeh Riazi, the assistant secretary-general for the UN's Office of Information and Communications Technology, explains why the UN focuses on identity.

"As technologists, when we look at blockchain, what we are promising is that you will have an identity. And if you're a refugee and you are stateless, it doesn't matter where you are, [your identity] travels with you. That's incredible because technology has been used to help the private sector for a long time. The internet was an explosion of information, of sharing information. Blockchain is about sharing value" (Daniell, 2018).

Consistent with Sustainable Development Goals (2015-2030) and target 16.9, to "*provide legal identity to all, including birth registration, by 2030*," blockchain-based digital identity solutions protect women's rights through immutable time-stamped records.

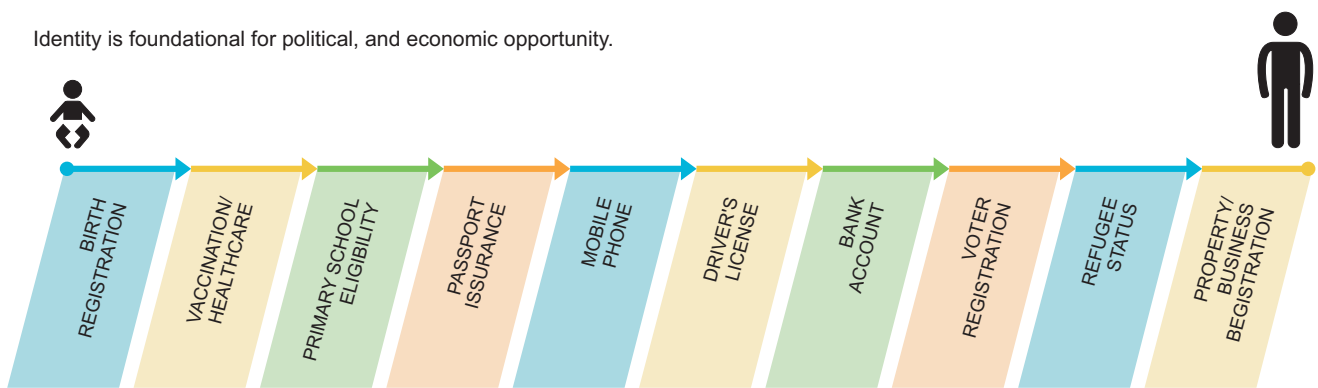
The ability for women to protect and own their identity is central in advancing their societal position. For a woman, when her right to be recognized under the law is stolen, it keeps her from attaining her rightful place in different stratas of society: at work, in her family, with civic involvement. Her identity is foundational for her political, economic, and social opportunity.

Blockchain Tracking for Modern Day Slave-Trafficking of Women and Children

Sustainable Development Goal Target 5.2 Eliminate all forms of violence against all women and girls in public and private spheres, including trafficking and sexual and other types of exploitation.

Sustainable Development Goal Target 5.3 Eliminate all harmful practices, such as child, early and forced marriage and female genital mutilation.

Global identity, or lack thereof, is a major concern in human rights abuses and crimes. Human trafficking accounts for a \$50M USD underground market annually (UN Women, 2017). According to *UN Women*, over 70 percent of all trafficking victims are women and children. Three in four trafficked women and girls are sexually exploited. Global estimates indicate that the births of approximately 230 million children under the age of five have never been recorded. In reports by the UNODC's *Global Report on the Trafficking of Persons (2016)*, "victims were largely trafficked for sexual exploitation, while trafficking for forced labor was also registered." For



A sample of potential public & private services that require a proof of identity

Without a way to prove who they are, these individuals are often unable to access critical social and financial services, such as voting, healthcare, education, mobile communication and banking. Furthermore, they are vulnerable to violence and exploitation, including human trafficking.

Fig. 1. Importance of identity (Source: ID 2020 Alliance).

child victims, most “were forcibly engaged in the production of goods and delivery of services, such as domestic and agricultural labor.” Trafficking engages these kids in “forced marriage, benefit fraud, pornography production, and organ removal.” According to the Report, “the legal invisibility of unregistered children makes it more likely that their disappearance and exploitation will go unnoticed by authorities.”

Invisible children are those under 5, with no birth certificate, at risk of falling into hands of traffickers with fake IDs, being transported across borders in serious illicit activities, (sex trade, illegal human organ trade), and missed by social programs offered by governments or development agencies. The UN’s International Children’s Emergency Fund (UNICEF) recognizes the “cost of trust,” and the difficulty of tracking international transactions. As UNICEF engages in several engagements, they suffer from some degree of mismanagement, and the potential for fraud (Simonsen, 2017).

In absence of ID documents, children have no means of proving their existence, and thus, become “invisible” to governments. The girl child who has been forcibly displaced is subject to the same dangers and obstacles that adults face. Cross-border migration, with loss of parents and relatives, results in dissipation of authority figures, and culminates in the breakdown of social networks. She suffers from discrimination and prejudice, with poor access to education, housing and health. Thus, falling prey to traffickers, leaving her exposed and vulnerable. The displaced girl child loses valuable childhood years, and with them opportunities for her economic, social and personal development.

Those women sold as cross-border brides both domestically and overseas, can now have an identity on the blockchain. While traveling or being transported, authorities have an automatic way to check the woman’s whereabouts, her personal information and history, to verify who she is and where she is going. This applies to traffickers and pimps as well (Kawaguchi and Lee, 2012).

Moreover, global supply chains are notoriously complex, with a diverse set of stakeholders, varying interests, and many third-party intermediaries – challenges that blockchain is well suited to address due to the nature of the technology.

Her Proof of Authorship and Ownership on Blockchain: Blockchain technology records movements and traces steps of those trapped in the system. Those women and children with recorded identification documents on a Blockchain have an instant, permanent, and verifiable way of proving their identity, academic credentials and career skills. Through its tracking and identity-based solutions, Blockchain will drastically reduce trafficking and exploitation of women under SDG 5.2, as well as curb sexual exploitation of women and girl children under SDG 5.3.

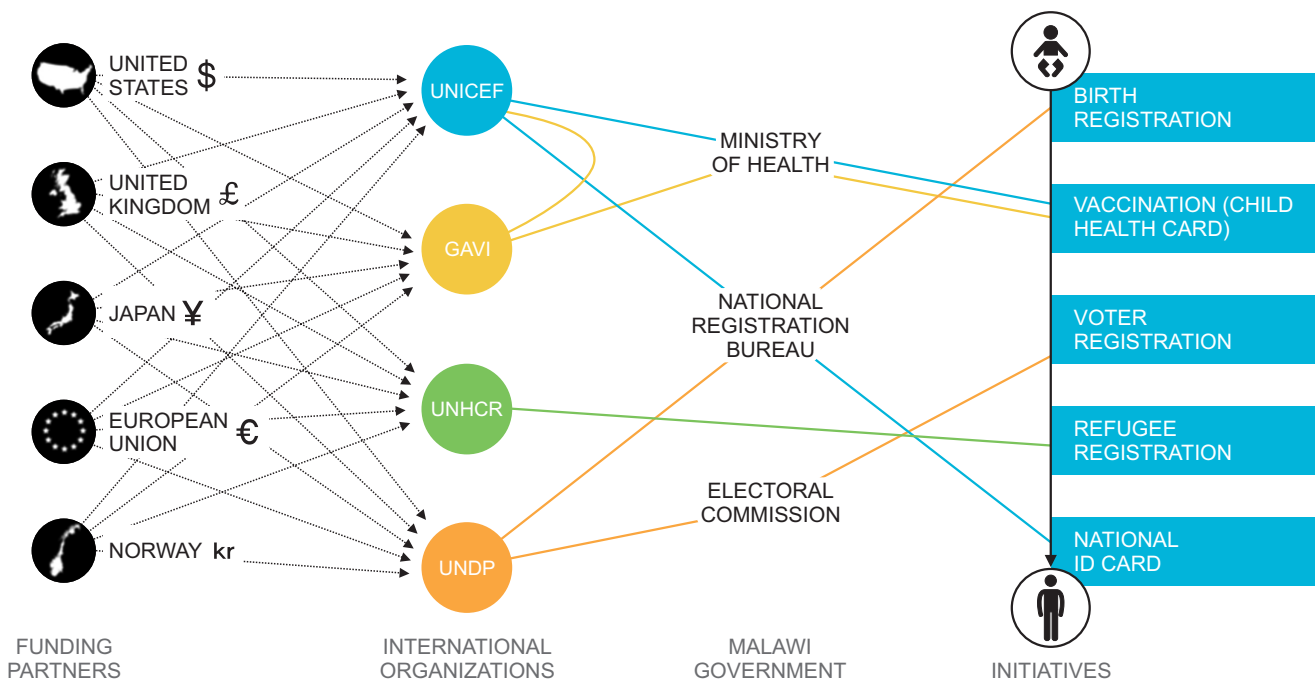


Fig. 2. Blockchain on ID 2020 (Source: ID 2020).

The next few sections will discuss blockchain case studies piloted in this area.

· **Resolving Trafficking on Supply Chains:** In line with UNGC's Women's Empowerment Principles, partnerships between local organizations and authorities in identifying trafficked or missing girls and women provide invaluable services. For example, Microsoft is collaborating with ConsenSys and Blockstack Labs to build a blockchain-based identity system. This is an open source, self-sovereign ID system helping authorities track both criminals and victims of human rights violations. As part of the ID 2020 alliance, a woman has her birth registration, vaccination (child health card), voter registration, refugee registration, national ID Card, and more metadata stored securely in a one-stop shop on the blockchain-based ID system. The project is in pilot-phase, and will scale in years to come.

To tackle the issue of child trafficking, Sovrin and ixo Foundation, a consortium of independent consultants, are recording the child's identification as a single source of truth on a universal blockchain platform verifiable through a digital cryptographic signature, or the child's physical biometric data. Here, smugglers, corrupt local government, counterfeit documents, and loosely regulated borders, will not be an obstacle in verifying who the child is. Using digital QR codes and scannable IDs, physical child trafficking, i.e., passing down from hand to hand will be prevented.

Taking this a step further, Slavefreetrade, a universal supply-chain operating system on the blockchain, "aligns with the United Nations Sustainable Development goal 8.7" along with eradicating modern slavery by enabling and motivating business to clean slavery from their supply chains." Presently, the "distance between people in ... the supply chain ecosystem has resulted in a lack of knowledge by consumers about who and how products are made, a lack of respect for the human rights of 45 million workers, and a lack of clear sight and responsibility to the end of every supply chain." (slavefreetrade, 2017).

At each step of the product, Slavefreetrade records on the blockchain, information down to individual lot number. Instead of disparate paper-based records, blockchain has a snapshot of each point of entry for the good, down to the humidity and sensor conditions to logistics and operations. By certifying slave-free products with a consumer facing slavefreetrade label, those along the ecosystem will track its provenance to the origin. Walmart's blockchain pilot for food traceability in pork and mangoes on IBM's HyperLedger blockchain is another example

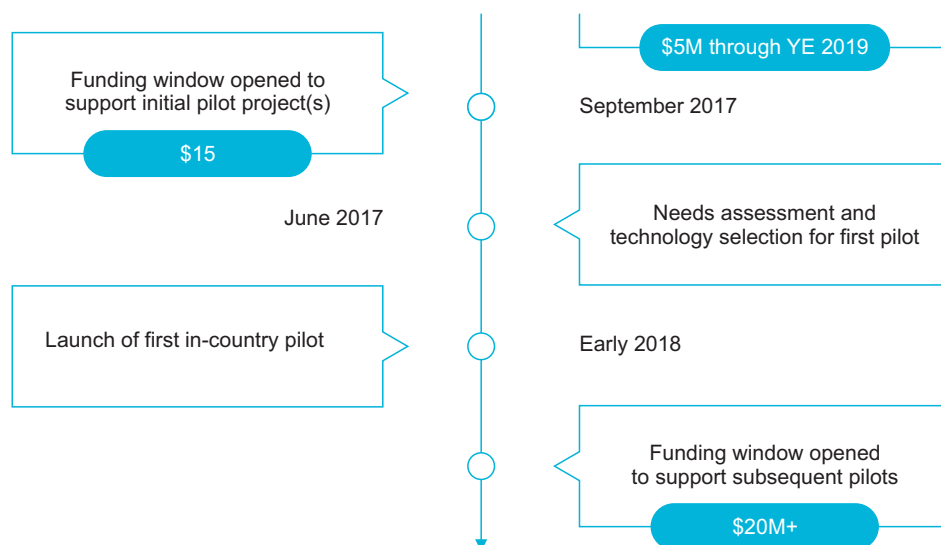


Fig. 3. Timeline for ID 2020. <https://id2020.org/partnership/> (Source: ID 2020).

of tracking food across supply chains, while recording the movement of entities and individuals associated with it.

Under the umbrella of Non-Financial Metrics of blockchain, as of March 9th, 2018, Zurich-based *Rothbadi* released its Social Impact Bond 2.0, a new social finance crypto instrument. (Mellish and Taeed, 2018) that incorporates non-financial value as total value and digitizes it on the blockchain with Seratio measurement systems (Social Earnings). While creating both a financial and non-financial token that are independent of each other, Mellish and Taeed (2018) state that the use of “non-financial tokens allows transfer of ownership of the non-financial interest in the social enterprise. This can be performed independently of the central organisation – i.e. to sell or transfer the non-financial assets.” They will promote this as the cryptocurrency investment bucket.

In addition, the Seratio Enterprise Blockchain Platform is an all-in-one blockchain environment (platform) that enables beneficiaries to keep track of the value and impact they make, and most importantly profit from it in different ways.

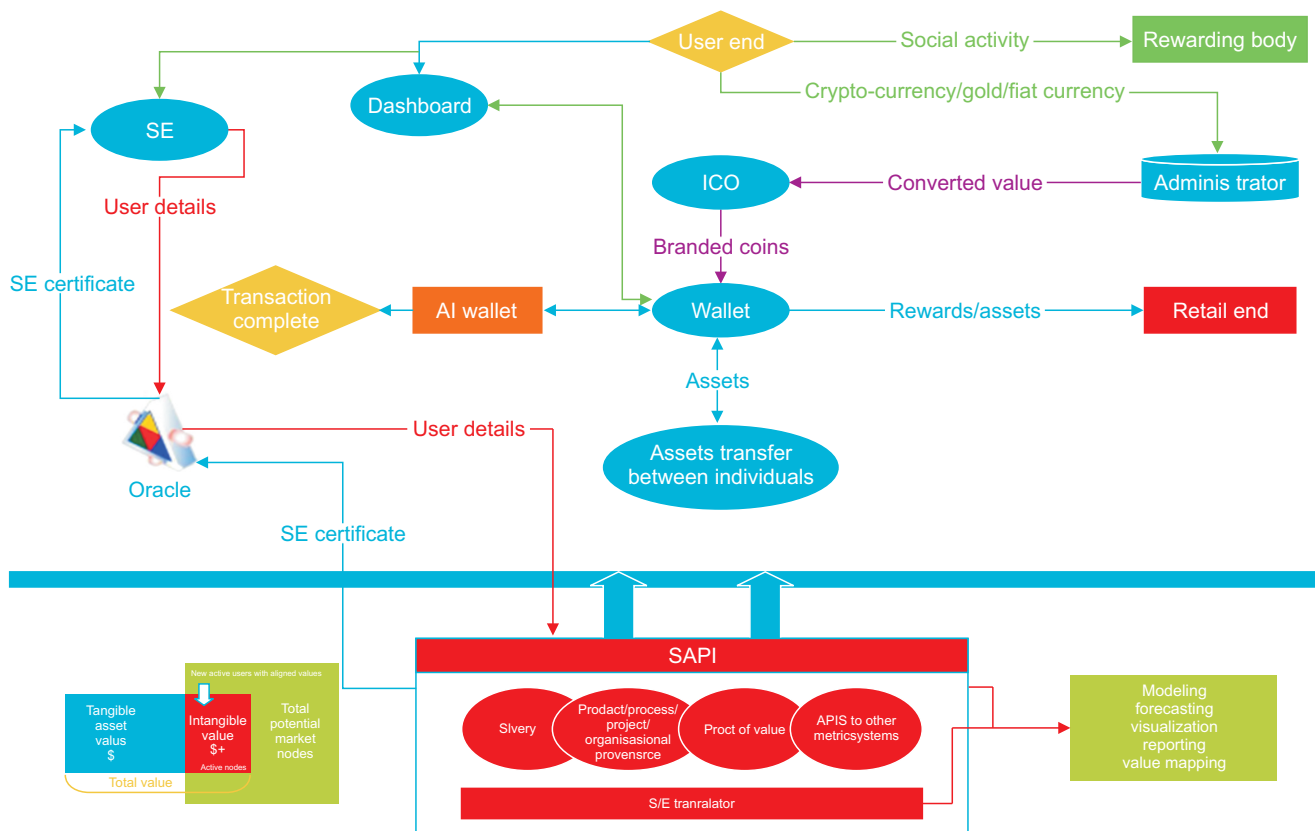
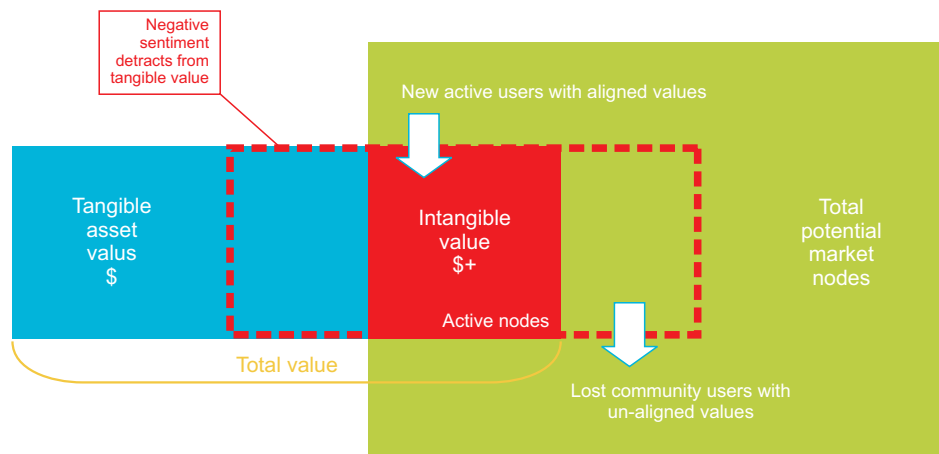
“It allows entities (whether individuals, companies, organisations, institutions, etc) to earn, transact, spend, trade and monitor their digital assets. Precisely, our vision for the Seratio blockchain platform is to unite and manage under three key themes:

- Cryptocurrency (financial assets) linked to intangible value and sets of values
- Tokenised Currency (non-financial assets) linked to intangible value and sets of values
- Provenance (both financial and non-financial assets) traceability recording and tracking”

Thus, Seratio captures both the tangible and intangible asset value to the market nodes (people or entities) while keeping the SE coins in a safe, secure wallet for transactions to the nodes without an intermediary.

· Access to Goods and Services on Blockchain: Over the past year, with the generous support of Innovation Norway, UN Women has been assessing the potential of leveraging blockchain technologies to address challenges faced by women and girls in humanitarian settings. As part of the work, UN Women, in partnership with the UN Office of Information and Communications Technology (UN OICT) hosted a four-day Simulation Lab from January 29 to February 1, 2018 at the UN Women New York Headquarters. They led hackathons to build innovative blockchain solutions for recording identification data and enabling secure money transfer for women entrepreneurs in the humanitarian context.

The Lab “enables UN Women to explore, in collaboration with the private sector, cutting-edge solutions that hold potential for closing gender gaps in humanitarian action. UN Women intends to pilot two to four solutions



In collaboration with the Rockefeller Foundation, Accenture and Microsoft have devised the most innovative piece of blockchain identity project: ID2020 Alliance, a Digital ID network on Ethereum blockchain. The public-private partnership has built *personal, persistent, private and portable* blockchain identities.

Traditional methods of food aid are perishable and susceptible to stealth. (Lymio et al, 1991). UN aid efforts have a historic problem of fraud, mismanagement, and bureaucratic red tape (WFP). Blockchain is a way for women to resolve the underlying issues with access and delivery of services and goods. It has revolutionized the ways in which food aid is distributed.

As part of its Building Blocks pilot, WFP is “trialling blockchain as a means of making cash transfers more efficient, transparent and secure. Cash transfers, through vouchers or pre-paid debit cards, allow people to purchase their own food locally and are an effective way to empower them to make their own purchasing decisions to relieve hunger. Cash transfers are an increasingly important means of providing assistance, with the number of people receiving WFP cash transfers growing steadily in recent years, from 3 million people in 2010 to 9.3 million in 2015” (WFP, 2018).

WFP’s approach was to adopt the Ethereum blockchain through Parity technologies. Parity transferred cryptocurrency vouchers totaling 10,000 people. They generated transaction reports matching disbursements to entitlements (funds) and vice versa. Refugees received necessary Food and Money and disaster relief. This used blockchain to track and verify ways families spend the fund. Next steps are to unlock data stuck in different aid agencies, including medical records from the World Health Organization, educational certificates at UNICEF, and nutritional data from WFP (WFP 2018). By using crypto vouchers, WFP and Parity are minimizing risk of inflation/deflation. Blockchain circumnavigates governments and banking institutions, therefore, transferring aid via blockchain can be far more efficient.

In January 2017, WFP in Pakistan has developed Building Blocks, a “*proof of concept* to confirm basic assumptions around the capabilities of blockchain in authenticating and registering transactions.” Implementing lessons from this trial, WFP built a more secure blockchain platform in the Azraq refugee camp in Jordan, where 10,000 refugees pay for their food by means of entitlements recorded on a blockchain-based computing platform.

A year since these trials, “more than 100,000 people residing in camps redeemed their WFP-provided assistance through the blockchain-based system.” Due to Blockchain technology, WFP has a “full, in-house record of every transaction that occurs at that retailer, ensuring greater security and privacy for the Syrian refugees. It also allows for improved reconciliation and significant reduction of third-party costs. The next stage of the project will see an expansion to all 500,000 Syrian refugees in Jordan receiving support from WFP.” Until now, they have transferred \$1.4 million in electronic food vouchers on the Ethereum blockchain to over 10,000 Syrian refugees stationed at Azraq camp, Jordan (WFP).

According to James Green of the World Food Programme (WFP), by using blockchain technology to send cash to those in need, “WFP achieved a 98 percent reduction in costs saved from not having to deal with financial service providers. Moreover, money cannot be stolen or used in places unapproved by the WFP, helping to create robust micro-economies in remote areas while also connecting individuals there to global markets.” (Daniel, 2018). This is significant when talking about SDGs as in many households around the world, women are left in charge of preparing and gathering food for the family.

While using advanced blockchain designs, IrisGuard, and biometric registration data for authentication, a refugee woman in Jordan allows a shopkeeper to scan her iris and match it to the blockchain record. She does so without compromising her religious and cultural norms. Refugees purchase food from local supermarkets in the camp by using a scan of their eye instead of cash, vouchers or e-cards.

According to Wolfond, with blockchain architecture it is possible to share information on a need-to-basis. “Right now, I would argue a driver’s license shares too much - A girl goes to a bar, and she has to share her name, address and weight with the bouncer. That’s crazy. All he needs to know is that she’s over 21. How to make this work electronically we couldn’t solve well until we saw it on Hyperledger” (Crosman, 2017). This suggests a system of identifying age without having to share valuable information with third parties that could in theory and in practice bring physical harm to them.

As this pilot takes off, she will have a robust identity of herself on WFPs blockchain.



Fig. 6. Biometric identification through the blockchain (Source: WFP Building Blocks).

· Access to Health on Blockchain: 5.6 ensure universal access to sexual and reproductive health and reproductive rights as agreed in accordance with the Programme of Action of the ICPD and the Beijing Platform for Action and the outcome documents of their review conferences

Approximately over half (52 per cent) of women between 15 and 49 years of age, married or in union, make their own decisions about consensual sexual relations and use of contraceptives and health services. That statistic is based on available data from around 2012 for 45 countries, 43 of which are in developing regions. In line with 5.6 sexual and reproductive rights - 5.6.1 and 5.6.2 - with blockchain female patients handle their internal chain of custody to make informed and cost-effective decisions in tracking their health as well as money spent on drugs and healthcare. It also touches upon SDG 5.2 and 5.3 to reduce female sexual exploitation and assault through blockchain verification and one-stop records.

As Fig. 2 depicts, a Dutch company called LegalThings, whose primary business is creating digital legal contracts, launched beta testing of an app called LegalFling that promises to be “the first blockchain-based app to verify explicit consent before having sex” (Bernard, 2018).

By stating boundaries and rules, the app clarifies a situation, where a party consents to “sex, but not to having nude photos of themselves taken.” To address these gray areas, LegalFling lists several categories - photography, condom use, and STD testing. Then, it sends “requests to their sexual partners via a messaging app. Accepting such a request is, in theory, agreeing to the preferences stated by the partner. That acceptance is then digitally recorded on the blockchain.”

The sexual consent app on the blockchain is a first step preventive measure, in eliminating sexual abuse and harassment. It is a check on non-consensual behavior, and acts as a trusted record-keeper of events. The implications of such a technology to record consent of women for evidentiary purposes will give power back to women and girls in ensuring their autonomy is respected and data can also be leveraged to ensure violations committed against women can be prosecuted.

In healthcare and drug reform, several women entrepreneurs are focused on solving healthcare problems with blockchain. PointNurse helps with logging and monitoring nurse hours, women’s health, and electronic health information on the blockchain. In SimplyVital Health, blockchain technology creates a secure audit trail for care. Patientory “empowers patients, clinicians, and healthcare organizations to access, store and transfer information safely, thus improving care coordination while ensuring data security. Patientory interconnects with any EHR system and enables doctors, care providers and consumers to communicate on a single easy to use the platform. We also connect consumers to connect with the broader community. Patientory uses blockchain technology to ensure end-to-end encryption while adhering to regulatory guidelines and compliance requirements.” Gem is using blockchain technology “to provide data transparency, change-auditing and fine-grained access control to

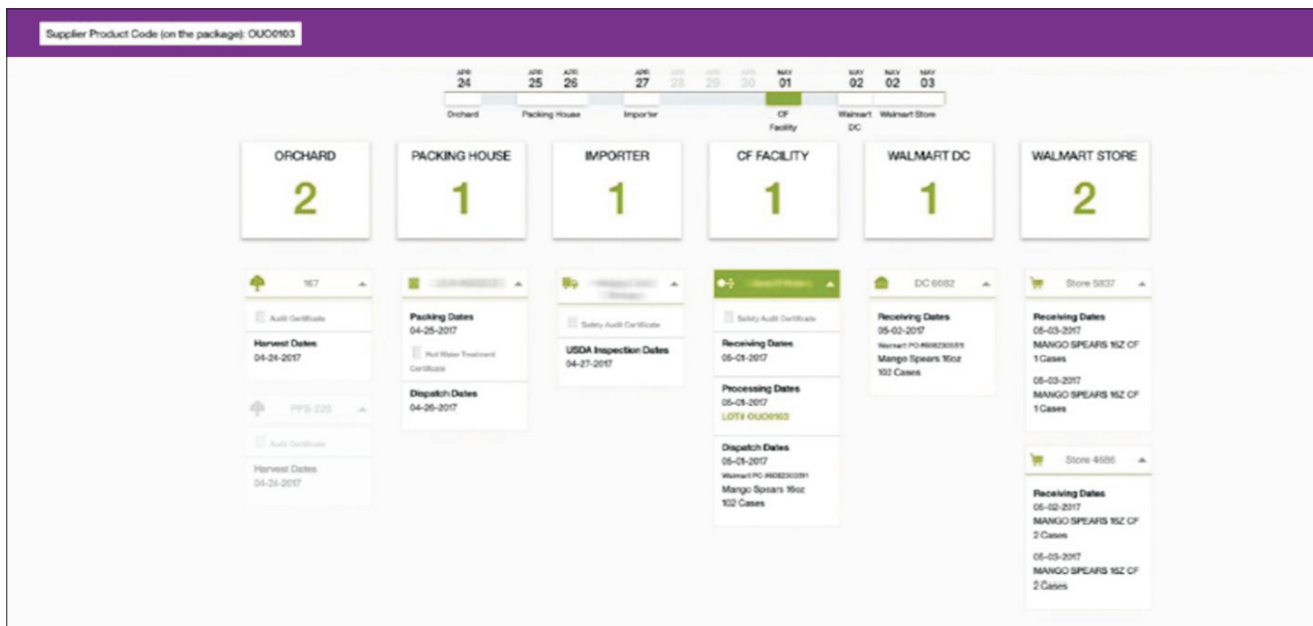


Fig. 7. Walmart food traceability on IM hyperledger blockchain (Source: Kamath, R. Journal of British Blockchain Association).

health records.” The solution tackles three issues of the healthcare industry: “(1) lack of real-time transparency into health claims transactions involving providers and payers; (2) amount of time it takes for providers to get paid for their service; (3) slow rate of provider reimbursements because of the time it takes to generate and deliver the patient’s Explanation of Benefits” (Gem, 2018).

In Gem’s case, Blockchain technology “addresses the trade-off between personalized care and operational costs by connecting the ecosystem to universal infrastructure. Shared infrastructure allows us to create global standards without compromising privacy and security.”

For women, such access to medical information is a game-changer. Women can now make decisions about her life, her body, and her medications. They have autonomy and independence in choosing medical providers and physicians with a snapshot of individualized and personalized medical history and logs.

An example of a food-based blockchain solution that has implications for drug delivery is Walmart’s blockchain pilot for food traceability in pork and mangoes on IBM’s HyperLedger blockchain (Kamath, 2018). It negates the traditional OUOD approach (One Up One Down) traceability approach, and tracks the entire supply chain from farm-to-table in a mere 2.2 seconds, which previously took 7 days. In access to healthcare and drugs, this means empowering female consumers with availability of reproductive drugs under SDG 5.6 with one-touch snapshot of the history of the drug and its source.

Women and Property

Sustainable Development Goal Target 5.A: Undertake reforms to give women equal rights to economic resources, as well as access to ownership and control over land and other forms of property, financial services, inheritance and natural resources, in accordance with national laws.

Blockchain technology is disrupting traditional forms of record systems (Koch, C. and Pieters, G, 2017). In a plethora of countries around the world, property systems are arcane and worn-down. Consistent with SDG Goal 5.4 and 5.4.1, men are perceived to be the primary breadwinners of the family, while women hold secondary roles and titles. (Scott, J. and Clery, E., 2018). Given the situation, property is naturally passed down from father to son, with women having little to no say or ownership in the transfer.

Tying neatly into SDG 5.1.1, “whether or not legal frameworks are in place to promote, enforce and moni-

Illustration from the solution by consortia formed by independent consultants, sovrin and ixo foundation

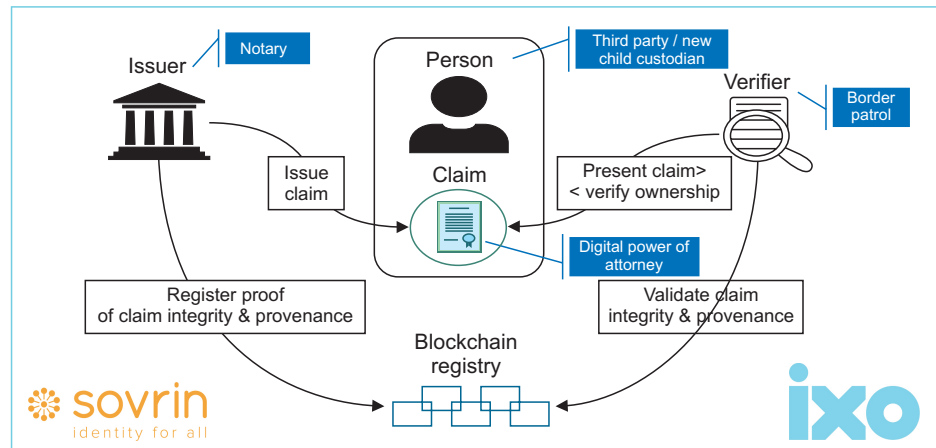


Fig. 8. Sovrin and ixo foundation, identity solutions (Source: ixo Foundation).

tor equality and non-discrimination on the basis of sex,” blockchain is a technology that can provide a chain of custody from generation-to-generation, that can be leveraged woman-to-woman, each acting as a node in the transfer. These “ownership registries” that can be recorded on the blockchain, will track property lineage with ownership details secured privately among involved parties.

Not limited to real property, but also women’s personal property, i.e., movable goods can be recorded. For instance, a vehicle registry stores hashes of car data (pictures, VIN, license plate) with an immutable record. Parties, such as female owners, the insurance company, buyers, sellers, transferees, transferors of the vehicle have access to that metadata. If due to a faulty chain of title, a woman is unable to prove her record ownership of a piece of property, then the blockchain can be used to prove ownership. This is particularly important for women who find themselves at the center of property ownership disputes at the end of a relationship, where sometimes legal papers can be misplaced.

Also, as a tamper-proof system that shows evidence of fabrication, the blockchain, with recorded owner and transfer titles, will track property ownership showing who the rightful, legal owner is. The blockchain hash, a cryptographic number, will verify what, who, how, and when something was passed down to the next person. The woman, in this scenario, will be the de-facto beneficiary of the property in a court of law, or otherwise.

Blockchain in Financial Inclusion of Women

Sustainable Development Goal Target 5.4: Recognize and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally appropriate.

More than 2.5 billion adults (majority being women) do not have a bank account or use formal financial services, making it difficult to weather a period of hardship, or move out of poverty (World Bank, 2016). Traditional money markets require access, as well as a sophisticated level of financial knowledge. Many women are unable to authenticate themselves on time to access benefits they may otherwise be entitled to. Over 2 million people engage in cross border payment with 800 million families, which accounts for \$400 billion in payment (UN Stats, Ripple). Transactions costs themselves are over \$30 billion per year.

The Organization for Economic Cooperation and Development (OECD, 2018) highlights the importance of tracking money for women’s economic empowerment - as “women’s capacity to contribute to and benefit from economic activities on terms which recognize the value of their contribution, respect their dignity and make it possible for them to negotiate a fairer distribution of returns – is a prerequisite for achieving gender equality and building inclusive and prosperous societies.” Caroline Rusten, UN Women’s humanitarian and crisis response

lead, told ETHNews, that blockchain “is also a way for us to look for and find solutions that can work in the field in humanitarian settings. Bringing these vendors together in this event allows us to do a dry test on different solutions” (Daniell, 2018a).

Blockchain technology provides access to payments and the ability to safely store money. As a widely accepted form of payment internationally, cryptocurrencies can be used to transact across borders to fund women’s initiatives, while beneficiaries could spend the crypto currency on products and services. While automating and decentralizing payment systems, the bitcoin blockchain using cryptographic public-private keys and self-organized ledger networks, verifies sufficient balances through nodes. (Koch, C. and Pieters, J, 2017).

Moreover, Blockchain technology reduces the function of an intermediary. In removing the broker-in-the-middle, banks can increase revenue generation and build enhanced customer relationship with women. Connecting women with digitally-based financial tools and services requires accessible, secure and verifiable ID systems.

Stellar Lumens, Ripple, BitGive, are a few examples of blockchain projects in the world of international remittances. For example, Ripple uses a private permissioned blockchain as well as a cryptocurrency XRP, to transact worldwide (Cheng, 2018). Stellar Lumens is helping unbanked and underbanked people worldwide by giving away their cryptocurrency in an airdrop fashion (Besjer, 2018). BitGive uses blockchain ledgers in donor assistance programs to provide a transparent, trackable way for financial assistance to get into the hands of the needy, instead of being lost in operational expenses (BitGive, 2018).

For cash transfers and identity, WFP has implemented a cash-based blockchain solution that works in humanitarian settings. The *Building Blocks* project has revolutionized how the WFP engages in cash transfers. (Daniel, 2016).

Using reputational attributes to attest and validate the woman’s digital existence, Consensys has developed the uPort Identity solution to help the “more than 2 billion people in the world who don’t have state issued ID.” (World Bank, 2017). Identity providers, governments, banks and IT companies, cryptographically sign for valid “reputational attestations” through email addresses, Facebook URLs, or state issued ID. Community members essentially vouch for each other to enable them to develop and use this bootstrapped persistent and portable reputation to, for example, obtain a microloan on a decentralized lending platform and grow a small livelihood from there. For access to financial services offered by financial institutions in different jurisdictions, women can make use of a Know-Your-Customer (KYC) tool built on top of uPort and RepSys. These women are in control of their personal information (expressed as reputational attributes). The encrypted information can be selectively and granularly shared with targeted counterparties when the user deems it to her advantage. (Ohnesorge J., 2017)

Cryptocurrencies and Tokens: ICOs and DAICOs for Alternative Financing: Alternative financing models have been put forth by ICOs and DAICOs. An Initial Coin Offering, or ICO, “is a fundraising mechanism in which new projects sell their underlying crypto tokens in exchange for crypto tokens.” DAICO “combines the decentralized voting mechanisms of DAOs with the fundraising dynamics behind ICOs. Like ICOs, “DAICOs are based on smart contracts created by companies that intend to raise funds” ... [for projects] A DAICO contract starts off in “contribution mode,” specifying a mechanism by which anyone can contribute ETH to the contract, and get tokens in exchange. So far this looks just like a normal ICO.”

· Women’s Coin: A UK founded crypto currency, Women’s Coin[®] creates “a virtuous market place for women to meet, share ideas, support and product offering.” The Women’s Coin Foundation[™] (WCF) supports UN empowerment principles, delivering access to education for women and girls worldwide through blockchain technology (Women’s Coin, 2018). Below are the operations of Women’s Coin:

“Women’s Coin[®] crypto currency uses blockchain technology, Ethereum coin wallets and smart contracts. No need to have a bank. All you need is access to the internet through any device and have a smart wallet. You can get your Ethereum wallet, buy coins and spend them on your device easily and quickly. Worldwide payments: Sending Women’s Coins[®] across borders is as easy as sending them across the

street. There are no banks to make you wait three business days, no extra fees for making an international transfer, and no special limitations on the minimum or maximum amount you can send. P2P P2B P2C

Women's Coin[®] allows person to business, person to customer and person to person transaction. This prevents fraudulent use of cryptocurrency and increases security. Transactions are secured by military grade cryptography. So long as you take the required steps to protect your wallet, Women's Coin[®] can give you control over your money and a strong level of protection against many types of fraud.”

Women's coin, thus, makes cross border transactions easier and seamless through secure wallets and cryptographic hash keys. Women can invest in women, reinvest in projects, and build new projects on a transparent

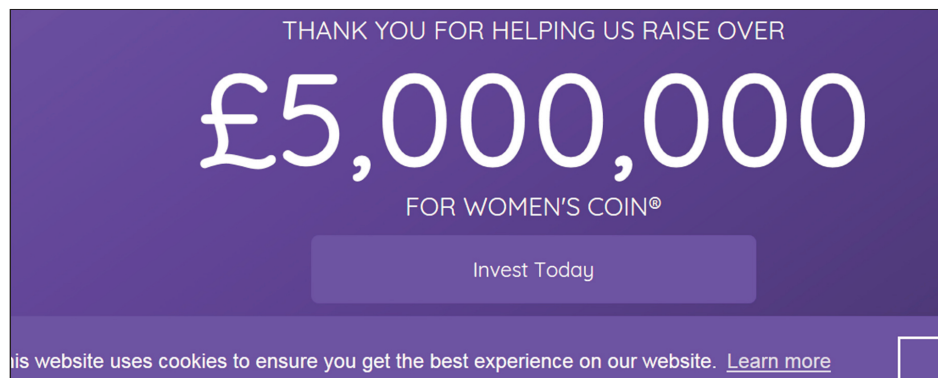


Fig. 9. Women's coin raise (Source: Women's Coin).

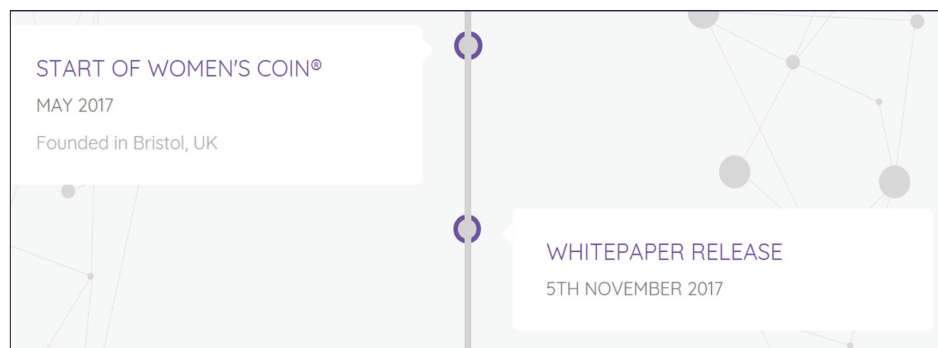


Fig. 10. Women's coin timeline (Source: <https://www.womenscoin.com/>).

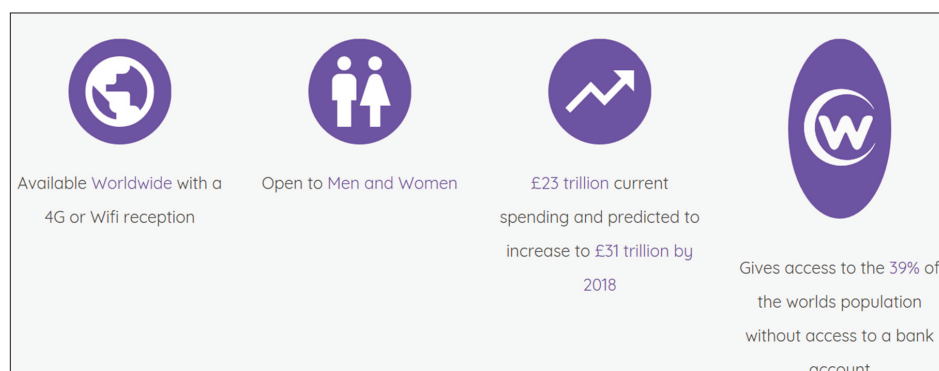


Fig. 11. Women's coin blockchain benefits (Source: Women's Coin).

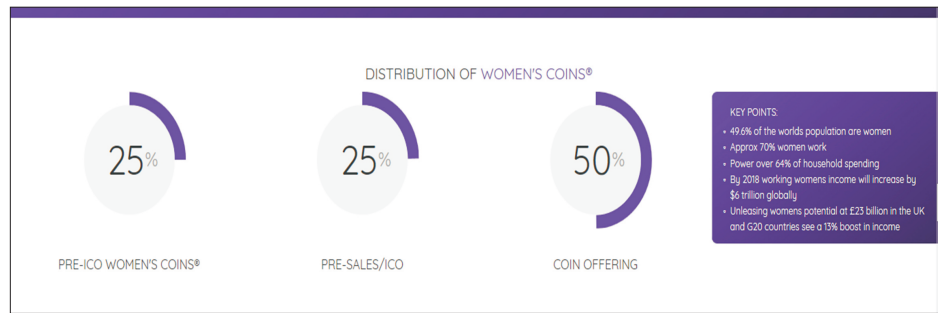


Fig. 12. Distribution of women's coin in initial coin offering (Source: Women's Coin).

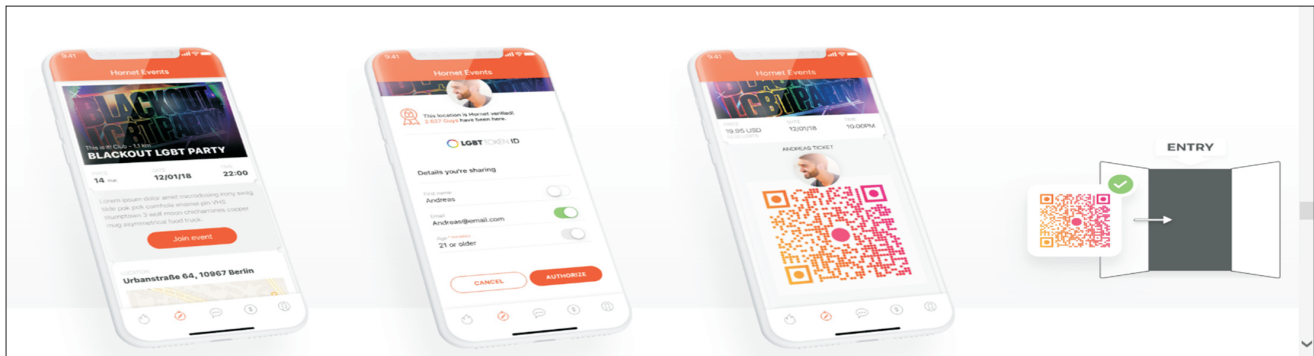


Fig. 13. LGBT token disbursement on the hornet app (Source: LGBT-Token).

and open platform.

• **LGBT Tokens:** It is well-known that in many countries around the world, Lesbian Gay Bisexual Transgender (LGBT) communities are significantly discriminated against in legislative and normative frameworks. For many seeking reform, the creation of the LGBT Token, the world's first cryptocurrency for members of the LGBT community and powered by blockchain technology, will touch upon three challenges: "(1) Enable members of the community to verify and protect their identities in transactions, (2) Demonstrate and utilize the economic muscle of the LGBT community, and (3) Allocate resources to tackle oppression, discrimination, and inequality against LGBT people"

The LGBT token facilitates quick and easy access to crypto by sending them anonymously to those with a smartphone. For example, an app called the Hornet provided behind-the-scenes support to evacuate over 70 Chechen gay men to safety during the recent wave of detention and torture of gay men in Chechnya. Hypothetically, if the LGBT token were sent to these men through the Hornet App, then they could have "anonymously, buy a plane ticket out of Chechnya, through airlines that accepted LGBT Token. These men, in theory, could have been out of Chechnya within 24 hours" (LGBT Token, 2018).

With low transaction fees, and money raised from fees to LGBT causes, the crypto token promotes welfare by having "users donate on the causes they were passionate about, with the potential of being the largest dedicated LGBT social responsibility program in the world." As Joint United Nations Programme on HIV and AIDS researcher Erik Lamontagne stated, "an increased spending power through transacting crypto creates greater LGBT acceptance." With a GDP of over 4.6 trillion dollars, "many places don't cater to the LGBT community (or outright won't serve/sell to us). The LGBT Token coaxes companies financially."

Her Growing Political Participation and Involvement in Governance

Target 5.C Adopt and strengthen sound policies and enforceable legislation for the promotion of gender equal-

ity and the empowerment of all women and girls at all levels.

Target 5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life.

Globally, women's participation in single or lower houses of national parliaments reached 23.4 per cent in 2017, just 10 percentage points higher than in 2000. Such slow progress suggests that stronger political commitment and more ambitious measures and quotas are needed to boost women's political participation and empowerment. Women are still underrepresented in managerial positions. In the majority of the 67 countries with data from 2009 to 2015, fewer than a third of senior- and middle-management positions were held by women.

The vital role of women and the need for their full and equal participation and leadership in all areas of sustainable development was reaffirmed in the Future We Want (paragraph 236-244).

IBM has showcased several potential blockchain use cases Good Government. These "cross internal and external organizational boundaries and depend on the ability to reliably share data in a secure permissioned manner. All transactions performed against the Blockchain requires consensus across the network, where provenance of information is clear and transparent. Transactions are immutable (unchangeable) and final. Examples put forth were "maintaining registries for land, companies and physical assets such as vehicles, managing records of consent, payment processes that do not need a bank account, identity management and authentication that would enable electronic voting and other online services, smart contracts linking councils, contractors, local residents to enable personalized services, and the ability to share open data more widely and at lower cost." (Thurlow, 2016). Blockchain can revolutionize government for women through pseudo-anonymous access to secure voting with minimal traveling required and done through the click of a button at a computer website or mobile app.

CONCLUSION

Blockchain, a frontier technology, impacts Sustainable Development Goal 5 by working as a platform for women, girls and gender minorities in achieving equality and empowerment.

SDG 5 and Blockchain need to work in tandem for each to fulfill its goals. For Blockchain and SDG 5 to work, trust building through its record keeping ability, is most essential. According to Kamath (2017), "ensuring shared value for ecosystem participants is critical to blockchain adoption; the participants need to have a strong value proposition to join."

Each SDG 5 Goal can be met through Blockchain's many attributes. It will be tried and tested now in 2018, and actualized and scaled in the near future.

With Blockchain, a woman can secure a digital personhood, while proving her identity and ownership, through time-ordered ledgers cryptographically sealed by public-private keys. This has tremendous implications on human rights and crimes, where Blockchain can track women and children in trafficking. It also has implications for a woman's property ownership and succession planning where she can trace her wealth and land to distributed registries that multiple parties have a copy of. She can be careful in what part of her identity she wants to reveal through the Blockchain.

In finance, a woman can own and monetize her data. She can utilize ICOs for alternative financing, have safe and secure bank accounts apart from a male presence, and transact in securing goods and services of their choices at a single location. Moreover, she can participate in governmental decision-making, and have greater access to healthcare and drugs and their personal, medical information.

Blockchain technology is bigger and broader than cryptocurrency and tokens. It is the back-end technology that can change the way women interact with each other, with men, their families and with their information. By bringing ownership, transparency and accountability to transactions and data, as illustrated by several examples in the paper, the United Nations SDG 5 Goals are being actualized and met through Blockchain.

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