Blockchain technology in Africa: problems and perspectives

Tecnologia Blockchain na África: problemas e perspectivas

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ABSTRACT
One of new technologies that has gained popularity within a few years is blockchain. Blockchain technology offers distinct advantages over database technology as it provides for thrustless recording of transaction data without relying on an existing intermediary. African countries need technological innovations, such as blockchain, to achieve economic development and converge to the level of other countries. These technological innovations can indeed turn the poor infrastructure of African countries from a weakness into a resource. The continent can be a laboratory where testing and validating new concepts and technologies.

The purpose of the paper is to analyse spread, problems, and potential of blockchain in African countries. Moreover, the paper presents policy recommendations as how countries could incorporate the technology towards achieving their economic transformation agenda.

The results indicate that this disruptive technology will be essential for African countries in the next few years and the legal and regulatory mechanisms will have to operate in many ways. In order to accommodate this, domestic and regional legislations and institutions would have to undergo some changes to handle blockchain becoming a certainty.

Keywords: Africa; Blockchain; Technology.

RESUMO
Uma das novas tecnologias que ganhou popularidade em poucos anos é o blockchain. A tecnologia blockchain oferece vantagens distintas sobre a tecnologia de banco de dados, pois fornece o armazenamento de dados sobre transações sem depender de um intermediário existente.

Os países africanos precisam de inovações tecnológicas, como o blockchain, para alcançar o desenvolvimento econômico e convergir para o nível de outros países. Essas inovações tecnológicas podem de fato transformar a infraestrutura deficiente dos países africanos de uma fraqueza em um recurso. O continente pode ser um laboratório onde se testa e valida novos conceitos e tecnologias.

O objetivo do artigo é analisar a disseminação, os problemas e o potencial do blockchain nos países africanos. Além disso, o documento apresenta recomendações de políticas.
sobre como os países podem incorporar a tecnologia para cumprir sua agenda de transformação econômica.
Os resultados indicam que esta tecnologia disruptiva será essencial para os países africanos nos próximos anos e os mecanismos legais e reguladores terão de funcionar de várias formas. Para acomodar isso, as legislações e instituições nacionais e regionais teriam que passar por algumas mudanças para que o blockchain se torne uma certeza.

**Palavras-chave:** África; Blockchain; Tecnologia.

1 INTRODUCTION

The Fourth Industrial Revolution (4IR) is characterized by the integration and control of production through the connectivity between equipment and sensors between the physical and the virtual world. This process generates enormous changes in the industry through technological developments such as increased productivity, autonomy, and redistribution of work. Ford (2015) uses the term 4IR to describe the future scenario of the industry, where the combination of computational cognitive power is used in tune with robotics in the production process. In other words, the new industrial paradigm is a complete interaction of production and distribution processes. Through computational cognitive power, machines and inputs exchange information throughout operations such as production, logistics, purchasing and inventory autonomously.

Together with artificial intelligence and robots, one of the innovations available to industry 4.0 is the blockchain.

The blockchain (chain of blocks) is the emerging technology that has gained popularity within few years. Blockchain technology offers distinct advantages over database technology as it provides for thrustless recording of transaction data without relying on an existing intermediary like a bank in the case of financial transactions. It offers its participants a highly secured ledger system.

Blockchains are shared (‘distributed’ or ‘decentralised’) digital archives which use cryptographic systems to authenticate the creation and transfer of digitally represented resources or information over a peer-to-peer network. They work through an advanced combination of disseminated consensus protocols, cryptography, and economic incentives founded on game theory.

The absence of efficient formal institutions—rules, laws, regulations, and their enforcement — can be overcome using blockchain, which consequently could be a disruptive technology for developing and less developed countries.
The aim of this paper is to highlight the infinite possibilities that this technology can provide to African countries. Indeed, in the media, the analyzes of this technology are reduced, most of the time, only to investigation of the role of cryptocurrencies. Thus, it is important to evidence that cryptocurrencies are a small part of what represents the potential of this technology.

Therefore, a wider and deeper investigation of the possible uses of blockchain is necessary.

The paper is composed of 4 sections, including the introduction. The second section presents blockchain technology from a general point of view, while the third section evidences the possible uses of the Blockchain in Africa: property rights, controlling corruption, refugees, democracy, health, education, energy, currency and banking, environmental challenges, and prevention of crimes; finally, the last section concludes the paper.

2 BLOCKCHAIN TECHNOLOGY

Blockchain is a kind of distributed database that saves a permanent and tamper-proof transaction record. The blockchain database contains two types of records: individual transactions and blocks.

Figure 1 shows two individuals (which could be two groups, two companies, etc.) making a transaction of any kind. A new block is created with all the data relating to the transaction. The block, which also includes other transactions, is prepared to be subjected to verification and approval by the participants in the blockchain.

Figure 1. The transaction becomes part of a Transaction Block.

Source: Own elaboration

The transaction is brought online to be verified by the participants in the blockchain (Figure 2).
After the verification, the new block is added to the block chain that forms the blockchain, is accessible to all participants and is in the archive of all participants. It becomes the permanent, immutable and unchangeable reference of that specific transaction.

A block is the elementary part of the blockchain (Figure 3) where some or all of the most recent information are recorded and, once filled up, it is archived on the blockchain as a permanent file. The creation of a new block occurs in accordance with the completion of the previous one. Every blockchain is formed by innumerable numbers of blocks that are linked to each other - like a chain - where each block contains a reference to the previous block.

The rule for storing new transactions in each block is the time these were processed. This combination of information and time generates a ledger that stores value or other resources in the database.
After the transactions are loaded on the block, a signature or "hash" is added to the end of the block. The hash is linked to the previous block in the chain, as evidenced in Figure 4.

![Figure 4. The hash is linked to the previous block in the chain.](source)

These hashes form the links going back between the strings until reaching the genesis block. The hash incorporates the current block number, the next block number in the chain, the date and time it was signed (Nakamoto, 2008).

### 3 POSSIBLE USES OF THE BLOCKCHAIN IN AFRICA

Blockchain can be a solution to many problems afflicting African countries. Considering that Blockchain technology is decentralized and transparent, one of the main pulls of this technology in Africa is that it can overcome corruption and lack of institutions in the countries of the continent. In what follows, the subsections will analyse specifically, ten sectors/areas where blockchain can be applied to improve the quality of life of African people.

#### 3.1 PROPERTY RIGHTS

Land transaction records are among the most essential guarantees of property rights in a country. Given their impact to individuals and the entire society, each country must ensure that land transaction records are produced and kept in a manner that they are available in the future, showing a quality in the record and being managed in compliance...
with the law. In case this does not happen, the country may suffer losses in terms of transparency, public accountability, financial stability and human rights. Some advantages for using blockchain technology for land transaction recording cited in the literature are:

- the processing is more efficient and consequently there is a reduction in the cost of land transaction processing;
- the recording process incurs fewer errors;
- prevention of title fraud;
- higher levels of security, auditability and transparency;
- data archiving, and reduced susceptibility to natural or man-made disasters (Lemieux, 2017).

Around 90 percent of land is undocumented or unregistered in rural Africa (World Bank, 2013), making it highly exposed to land grabbing and expropriation with inadequate compensation.

First blockchain-based property register was established in South Africa. In 2019, the not-for-profit company Centre for Affordable Housing Finance Africa (CAHF) in partnership with the strategic research consultancy “71point4” and the digital lands transactions platform “Seso Global” have developed this project. The pilot project consists of an area of almost 1000 properties located in four sites in Makhaza, Khayelitsha. All the houses are government subsidised properties that have not yet been recorded on Deeds Registry (CAHF, 2020).

Another African country that applied blockchain technology to guarantee property rights is Ghana: the start-up “Bitland” uses this technology to help citizens to get property rights. “Bitland” conducts the operation in three phases: land survey, preparation of titles and land registry and land tokenization. In the first phase, the start-up leaves approximately 30 markers to work together with the members of the local community. The local members then place the markers in agreed-upon spots to mark boundaries between specific areas of land.

In the second phase, land registry, titles for the land are created by “Bitland” using blockchain technology. Firstly, the GPS coordinates of the land with its owners are verified. Secondly, there is the creation of contracts that includes owner names, GPS coordinates, map references, block numbers and addresses. Finally, all information is
stored in an online database. In the last phase, the land titles and associated files are converted into a token that is both tradeable and traceable (Miller, 2020).

3.2 CONTROLLING CORRUPTION

Blockchain has two unique elements that make it a powerful instrument against corruption.

Firstly, the security of the information and the authenticity of records it manages are secured at an exceptional level. Blockchain removes chances of falsification and failure in the management of data. Moreover, it increases the availability of information, reducing the possibility of bureaucrats to hide certain data.

Secondly, blockchain offers a transparent and decentralised system to register a sequence of transactions. Given the fact that transactions are recorded chronologically, forming an immutable chain, blockchain establishes an unalterable trail of transactions, allowing for the full traceability of every transaction. Consequently, a public blockchain provides prosecutors and law enforcement agents with a tool to detect illicit activity or malfeasance by leaving enough digital signs to isolate corrupt behaviours (Santiso, 2018).

Indeed, blockchain generates a tamper-proof digital record of transactions and shares the record, increasing in this way the transparency of information. Cryptography allows for access to add to the ledger securely. It is extremely complicated and sometimes impossible to modify or delete data recorded on a ledger. With these characteristics, blockchain allows to reduce or eliminate integrity violations such as fraud and corruption while at the same time it can reduce transaction costs (Kshetri, Voas, 2018a).

In the case of international help for less developed countries, blockchain can have a fundamental role in reducing embezzlement. For example, in the case of construction of a hospital, the blockchain can be a tool for tracing every financial transaction showing donors whether their money had been used on medicines, bricks, mortar or luxury products.

Moreover, blockchain enabled peer to peer payments eliminating the middlemen and consequently reducing the misappropriation of aid transfers. Using this technology, an international organization or ONG could transfer funding directly to beneficiaries without going through local power structures (Transparency International UK, 2017).
3.3 REFUGEES

Blockchain could tackle some issues relative to refugees.

The first issue is about documentation. Instability in several African countries has created new waves of migration, which causes a threat to human rights in many ways. Among these problems, we can highlight the weakening and loss of personal identity for migrants and, in particular, for refugees.

They often encounter huge difficulties to prove essential aspects of their identity. Most of the time, refugees lose the documentation proving their citizenship, their personal data and information, their professional diplomas and so this creates insuperable barriers to managing a decorous existence, accessing services and remaking their lives in the new countries. Although some have copies of their scanned documents in state archives of their country, this does not guarantee access to these documents. In some cases, their country refuses access to the document, in other cases, the archive or institution that held it has ceased to exist.

Blockchain comes as a solution in this situation: it takes the form of digital public ledgers that are free and open for all connected nodes; rather than belonging to a single organization, these ledgers belong to all the users connected to them, in this case the refugees. Refugees’ identities within a ledger are encrypted and hence known only to the users themselves. With blockchain these encrypted and verified identities are stored on the appropriate decentralized ledger, while cryptographic hashing creates a permanent layer of safety. (Morrow et al., 2018).

A second issue is relative to hunger. International organizations face many challenges while distributing aid for hunger prevention. For example, they need to keep a record of all transactions made in stores and marketplaces to identify and authorize purchases, in order to ensure appropriate use of funds and prevent misconduct. Blockchain was already used by the World Food Programme (WFP) to direct resources to thousands of Syrian refugees. WFP gave refugees cryptocurrency-based vouchers that could be used in participating markets, which sped up transactions while reducing the risk of fraud or data mismanagement (Bayram, 2018).

A third problem is relative to work. In addition to various problems that refugees face, many of them, years after arrival, are still in the process of having their asylum applications considered and authorized and, therefore, have limited access to work.
Blockchain can help the government and refugees to create digital work permits that would allow refugees to deal with employers or businesses directly (Bayram, 2018).

### 3.4 DEMOCRACY

Blockchain generates cryptographically protected voting records: votes are recorded accurately, permanently, securely, and transparently. So, there is no possibility to modify or manipulate votes. Moreover, blockchain protects participants’ anonymity while still being open to public inspection. Even though nothing is completely secure, tampering is almost impossible with blockchains (Kshetri, Voas, 2018b).

There are still no real examples of applying the blockchain to the voting system. However, Hjálmarsson and Hreiðarsson (2018), in their paper, presented a blockchain-based electronic voting system that uses smart contracts to allow secure and cost-efficient elections while ensuring voters’ privacy. Through an Ethereum private blockchain, it is possible to transmit hundreds of votes per second on to the blockchain, employing every aspect of the smart contract to reduce the load on the blockchain. Their election system gives the possibility to everyone to vote at a voting district of their choosing. Consequently, this system ensures that each voter is counted from the proper district, avoids double-counting fraud, and potentially increases voter turnout.

Moreover, blockchain can be used to reduce the spread of fake news during pre-vote periods. Audio and video software are becoming so powerful during election campaigns that power groups, politics or criminals can create what is known as deep fakes. Using a collection of existing recordings and computerized programming, voices and bodies can be changed or even entirely fabricated to benefit one candidate or slander another.

There are three ways by which blockchain is helpful to fight fake news:

- **Transparency in the news:** people would be able to discover if the news is fake or not, because blockchain gives the means to verify it.
- **Traceability of the news:** blockchain supports applications to trace the origins of the news.
- **Immutable approach:** news content, videos or images saved on the blockchain are unalterable as they cannot be modified, changed or deleted.
3.5 HEALTH

Blockchain technology is expected to enhance medical record management and the insurance claim procedure, speed up clinical and biomedical research, and advance biomedical and healthcare data ledger (Yoon, 2019).

Moreover, blockchain technology allows patients to give access rules for their medical data, for example, allowing specific researchers to access parts of their data for a fixed period of time. Through blockchain, patients can connect to other hospitals and collect their medical data automatically (Gordon, Catalini, 2018).

Ndubuisi (2018) highlights that Africa is suffering a massive emigration of healthcare professionals to Western Europe and North America. African governments have tried to stop this migration without results, since African doctors and other health professionals normally earn more outside their countries.

Thus, while population is quickly increasing in most of Africa, its countries are losing their health professionals, tired of the work situation at home and attracted by the ease with which foreign countries can hire them.

This is where blockchain offers solutions. If blockchain systems could deal with some of the minor healthcare problems, the available healthcare professionals could concentrate their effort on the most challenging issues. (Ndubuisi, 2018).

The European Commission has launched “CareAi” in June 2018, which is a digital computer system connected to a blockchain that uses a patient’s blood sample to quickly diagnose diseases (malaria, typhoid fever, tuberculosis, etc.) without the presence of a physical doctor. The computer system is engineered to help the invisible demographic of migrants, ethnic minorities, and those unregistered within traditional healthcare systems. So, it is possible for these invisible groups to get access to basic healthcare, and useful appropriate information without compromising their identities, for fear of deportation. This is important for all societies, because without access to health services, these communities may cause health problems to the whole population. (Ndubuisi, 2018).

In Tanzania “AID:Tech” and “PharmAccess” are utilizing AID:Tech’s blockchain platform to collect and validate digital health data to make antenatal care more effective.

The project provides each pregnant woman a digital ID that allows them to get pregnancy vitamins such as folic acid and follow the pregnancy’s progress via data.
included in the blockchain. The data include, for example, registration, medical appointments and birth.

The system is now the driving force behind the mothers obtaining access to postnatal care, medicines and follow up appointments as required (Clarke, 2018).

Kenya shows another use of blockchain for health purposes. “Nurse in Hand” built, jointly with “Apla Tech Company”, a blockchain-based accident and emergency response platform. The aim of mobile application is to reduce the high rate of deaths that is mainly caused by the slow response of ambulances and nurses during accidents both at home and on the road. To minimize the response time and distance, paramedics recorded on the “Nurse in Hand” platform work normally in Emergency Care Centers that are within the geo-mapped locations and are equipped with life-saving GPS-tracked Emergency Kits. “Nurse in Hand” platform is managed using blockchain technology (Odhiamb, 2018).

3.6 EDUCATION

Atienza-Mendez and Bayyou (2019) evidenced many areas of blockchain application in education, among which we can evidence:

- Online Education: validity and security are extended with blockchain innovation. The blockchain can also create non-modifiable learning records for online instruction, without the required third-party participation for monitoring it, and guarantee the reasonable acknowledgment of course credits. This is important for developing countries because it can be created a secure system to provide education to the remote areas of each country.

- Learning outcomes and diplomas: using the blockchain, the quantitative and qualitative combination of grades, process and evidence, the course name, learning outcomes name and the weight of the course, etc. can be digitized. The transformation of the data of student evaluation into employment competence can also be done by sending student skill evaluation directly to a digital curriculum. Through the educational block, graduated students have not only a diploma, but they can save all information about their learning process.

South Africa has already planned to apply blockchain to education. The government created a subsidy scheme for pre-school centres to benefit children from disadvantaged households. These children receive access to quality preschool education, care and nutrition. Most of these pre-school centres are located in the country’s poorest regions and are normally run by local women from the local community in an informal way. South Africa manages presently pre-school centres through paper-based information systems that provide little data, trust and efficiency, but in the near future the objective is to digitize all this information through “Amply”. “Amply” is a mobile platform that utilizes the blockchain to deliver accountability and transparency in the subsidy
management, along with better information collecting and data security for children. The project is developed jointly by the South African government, the UNICEF Innovation Fund and the Innovation Edge (Conway, 2018).

3.7 ENERGY

In Africa, the high costs of generation and distribution of energy cause a situation of imbalance between supply and demand: the demand for energy is much higher than the supply.

Access to energy is essential for the attainment of necessary outcomes in terms of inclusive development. Energy is necessary for health, education, business and creating jobs. Insufficient energy access causes many deaths annually due to the use of wood-burning stoves for cooking; reduces the functions of hospitals and emergency facilities; compromises educational achievements; and increases the cost of doing business. Energy access for African countries is consequently one of the key drivers of inclusive growth since it generates opportunities for women, youths, children and minorities (African Development Bank, 2021).

To achieve the development objectives, the energy supplied must meet a demand that improves productivity. So, the expansion of decentralized energy must improve lives and meet critical needs of each country and society. Given the fact that blockchain eliminates intermediaries, it is possible to create an auditable encrypted ledger that can record energy consumption, credit records, including providing energy trading between households. In short, blockchain can give consumers more control of their energy conditions and consumption (Nsikak, 2018).

Blockchain ensures traceability of energy supply and that agreements between individuals are implemented automatically, ensuring additionally that demand is met by locally driven renewable energy, (Machado, et al. 2020).

In their study, Andoni et al. (2019) listed 140 blockchain start-ups, research projects and initiatives undertaken worldwide by companies and research organisations. In this list, only two projects are from Africa, specifically from South Africa: “Bankymoon” a start-up company, which is developing technological solutions that combine Bitcoin payments with smart meters, and “The Sun Exchange”, which allows to international
investors buy solar assets that are subsequently leased to consumers in South Africa, normally local schools and small-sized firms.

3.8 CURRENCY AND BANKING

A cryptocurrency is virtual money that can be used just as real money to buy things and services or save. In the banking system, cryptocurrencies can be extremely innovative, cutting out the intermediaries, such as credit card companies or banks, making it cheaper to transfer money from one virtual wallet to another.

Africa can take a big advantage from the use of cryptocurrencies: its countries have young professionals and entrepreneurs attracted by new technologies. Moreover, the high unemployment in many African countries causes young people to avoid traditional sectors and look for new ways to make business.

Another point to be evidenced is the mismanagement of local currencies by governments and hyperinflation in some countries. For example, during the devaluation of the Zimbabwean dollar in 2015, many people began to trade in Bitcoin.

The possible role of cryptocurrencies on remittances is a further issue to be analysed.

Considering the growing diaspora of African people and the enormous cost of bank transfers to send money back home, cryptocurrency can be a solution to send remittances across borders more cheaply.

Some cryptocurrencies allow people to basically send money back to African countries for free. For example, the remittance company “BitPesa”, based in Kenya's capital Nairobi, is a remittance company that utilizes Bitcoin as a medium for international money transfers. Thus, “BitPesa” gives the possibility to African emigrants to avoid bank fees and skips the cost of converting money into different currencies (Mules, 2020).

At the farm level, blockchain can help producers to increase profits, indeed sometimes it can be noted that high yield and production output are not the guarantees of prosperity for farmers in African markets. For example, countries of West Africa continue to be large importers of rice, while other countries in the world with similar natural conditions, like Vietnam, have become big exporters of this commodity.
Moreover, farmers are still poor, relatively or absolutely, compared to the rest of the economy. This is due mainly to a small bargain power of African countries in the commodity supply chain. A solution for these issues comes from “Binkabi”, which is a company that builds empowered commodity networks fairer and more profitable through collaborative efforts of the members leveraging blockchain technology. “Binkabi” benefits farmers in 3 ways:

1. farmers can sell their production to a larger (more highly liquid) market;
2. in the case that they opt to do not sell immediately after the harvest, they can use the commodity-backed tokens as collateral to borrow money from banks or P2P markets;
3. storing commodities appropriately diminishes post-harvest loss significantly.

All these benefits lead to higher income by farmers as demonstrated by countries with well-performing commodities trade (Sinclair, 2018).

3.9 ENVIRONMENTAL CHALLENGES

Blockchain technology can be utilized to overcome some environmental sustainability challenges. Chapron (2017) indicates that blockchain might support environmental sustainability through three key core mechanisms: product origins, behavioural incentives and resource rights.

Regarding the first mechanism, blockchain could give larger support to consumers and intermediary companies in supply chains about the environmental impacts of their purchasing choices. An example for this mechanism is “Provenance”, a UK-based start-up, which created a tuna-tracing system using blockchain technology. Another example is “BVRio” system in Brazil, which utilizes blockchain technology to trace wood products from source to final buyer (Herweijer et al., 2018).

Moving on to the second mechanism, blockchain could offer more certainty to people that they will be rewarded for eco-friendly behaviour. For example, the decentralized green fund, “GainForest” has developed a scheme to incentivise farmers in the Amazon to conserve rainforest, offering potential benefits. International financial rewards are paid according to the verification of the forest preservation by remote sensing satellites and blockchain (Greene, 2018).
In the last mechanism, blockchain can guarantee the rights to use natural resources. In turn, this guarantee could increase a right-holder’s confidence that their property/resource will be protected against expropriation, and that overuse will be identifiable. Consequently, this could prevent overusing the resource for short-term profit. There are few examples for this mechanism and most of them are in middle-income countries such as Ghana, Georgia and Brazil (Graglia and Mellon, 2018).

An example of a project involving all three mechanisms is the pilot program of the South African-founded diamond company De Beers, which announced that it is using blockchain to certify its diamonds are authentic, conflict-free and eco-friendly. Blockchain created an unalterable and secure digital trail from the selection of rough diamonds, through cutting and polishing, to the jewellers. Five diamond manufacturers (Diacore, Diarough, KGK Group, Rosy Blue NV and Venus Jewel) collaborated with De Beers to develop the blockchain platform called “Tracr”, which was introduced and made available to the rest of the industry in 2018 (Shabalala, 2018).

3.10 PREVENTION OF CRIMES

In African countries, fraud and other virtual crimes are common and sometimes the consequences of these criminal activities spread beyond the continent's borders. Cybercrimes and the consequent consumer diffidence are a limit for the growth of e-commerce on the continent.

A blockchain-driven cybersecurity system could be the most efficient way to prevent hard-to-trace cybercrimes in and outside Africa: individual data can be appropriately recorded in digital ledgers, partnering with organizations that can hold those that perpetrate crimes responsible.

Blockchain can prevent cybercrimes in four ways: the use of decentralized storage, the prevention of data theft, the inhibition of denial-of-service attacks (DDoS¹) and the promotion of IoT² security.

¹ A denial-of-service attack (DDoS attack) is a cyber-attack in which the perpetrator seeks to make a machine or network resource unavailable to its intended users by temporarily or indefinitely disrupting services of a host connected to the Internet.

² The Internet of things (IoT) describes the network of physical objects—“things” or objects—that are equipped with sensors, software, and other technologies for the aim of connecting and exchanging data with other devices and systems over the Internet.
The decentralized nature of storage used in blockchain technology implies that hackers no longer have a single-entry point, nor they can access the entire data repositories, even if they get in. Every participant verifies repetitively the data stored/shared guaranteeing that no false data is included, or no change is executed to the existing ones.

The prevention from data theft & fraud means that hackers need to damage data stored in every single computer in the global network to destroy a blockchain. Hackers need to damage data in millions of computers, which is nearly impossible, and as long as the data registry remains on at least one computer, the block will continue to exist. Consequently, bigger a blockchain network is, lower is the risk of being the victim of an attack by hackers.

In the case of DDoS attacks, blockchain makes it difficult for hackers to attack, given that this technology will completely decentralize DNS\(^3\), which will allocate the content to multiple nodes. The concept is to make the complete worldwide web decentralized so that all third parties can be removed from managing web servers, databases, and IT systems.

Finally, blockchain promotes IoT security and deals with multiple tools such as routers, switches, security cameras, etc. that share data to one another. Blockchain can increase IoT devices’ smartness by allowing them to make security choices without the need for a central authority (Hales, 2020).

In 2018, the International Criminal Police Organisation (Interpol) partnered with “VoguePay”, an online payments provider, to develop a blockchain-based information system for crime control in Nigeria. The platform, called “InterPort”, is allowing Interpol to access information and handle stakeholder activities and crime reporting (The Guardian, 2018).

4 CONCLUSIONS

By placing trust and authority in a decentralized network, rather than a powerful central institution, blockchain could reconfigure the way we allocate, secure and transfer many resources and services.

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\(^3\) Domain Name System (DNS) is a hierarchical and decentralized naming system for computers, services, or other resources connected to the Internet or a private network.
In this paper, we observed the potentiality this technology has and how it can be applied to African countries in several sectors. However, it must be evidenced what are the limits and challenges of its application to Africa and consequently what are the public policies that must be implemented to promote this technology.

The first challenge would be the lack of the internet infrastructure. Most of the connections work through satellites and the velocity is very limited. This means that some data might have trouble staying synchronised with the blockchain, and that blockchain may be probably more expensive than in developed countries.

A second challenge would be the implementation of blockchain: creating and programming this technology needs skills in cryptography and databases, and there is an enormous demand for professionals with these competencies worldwide.

A third challenge is related to the fact that blockchain technology is currently utilized worldwide in a regulatory grey zone. Companies and businesses may be averse to invest time and resources into research and development in blockchain because they believe that regulators might retroactively modify the rules. Institutions and regulators must provide assurance and frameworks so that investors can use blockchain without reluctance (Pollock, 2018).

Therefore, African government should implement some policies to overcome these problems and make possible the wide use of blockchain.

Firstly, governments should invest in the internet infrastructure and human capital that allows participation in blockchain technologies, including bandwidth, internet-of-things tools and digital education.

Secondly, policies must be implemented to create local innovation centres with capability in blockchain and related technologies to improve the benefits of blockchain to societies. Such centres should foster the skills required for blockchain and other technologies to boost a digital economy, including coding, cryptography and data science. The centres should also create partnerships with specialists of other countries to adapt blockchain solutions to problems facing communities in developing countries (Le Sève et al., 2018).

In conclusion, the results of this paper indicate that this disruptive technology will be essential for African countries in the next years and consequently each country must
restructure the institutions and formulate the policies necessary for the efficient use of this technology.

REFERENCES


Bayram, A.S. 2018. Here are three ways blockchain can change refugees' lives. World Economic Forum.


Le Sève, M. D., Mason, N., Nassiry, D. 2018. Delivering blockchain’s potential for environmental sustainability. ODI Briefing Note.
Morrow, M. J., Kovarski, M., Alfawakheeri, A. 2018. The Promise of Blockchain and Safe Identity Storage for Refugees. UNHCR.