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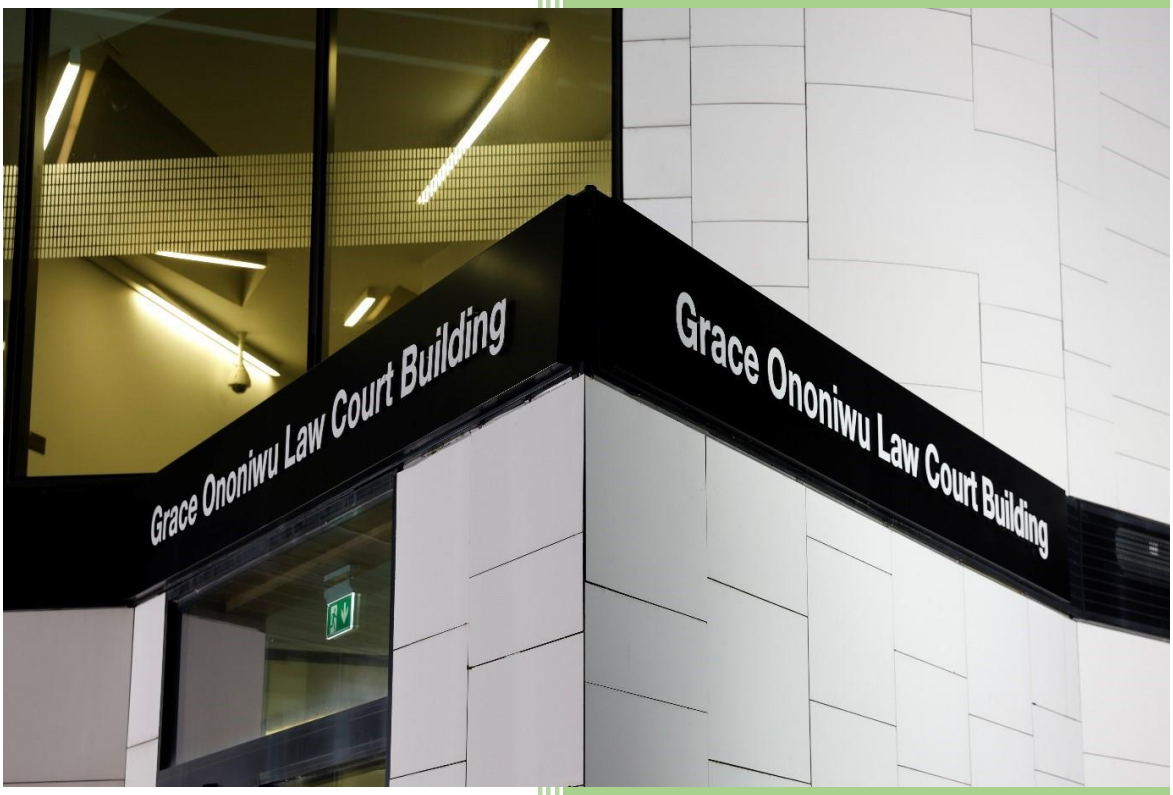
2023

'A Blockchain for Nigeria' – Exploring Blockchain Policy and Adoption in Nigeria



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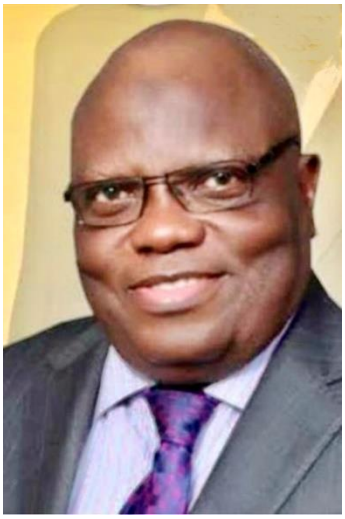

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Executive Summary

This White Paper puts forward the following policy decisions for consideration.

> **Recommendation 1:** Consider the development of a blockchain for Nigeria – 'Nigereum',[1] a new blockchain infrastructure for Nigeria. This provides enhanced cybersecurity, safeguards sovereignty, and reduces carbon emissions.
>
> **Recommendation 2:** Consider consolidating all government blockchain-based services, including the Hyperledger-based e-Naira, on Nigereum.
>
> **Recommendation 3:** NITDA to use its law-making consultative powers to propose new rules governing core developers of Nigereum to be subject to Nigerian laws and policies.
>
> **Recommendation 4:** The next iteration of the NITDA Blockchain policy to stratify capacity building, with a strategic focus on developing core developer capacity and hardware capacity in Nigeria, beyond the aspiration of creating low-, and middle-income talent populating the blockchain ecosystem.
>
> **Recommendation 5:** Consider negotiating a Data Embassy agreement with a third country. This will enhance cyber security and energy security for Nigereum.
>
> **Recommendation 6:** Implement STDM in parts of Lagos where there is a land tenure data gap. This will help provide fuller data for the Nigereum-based land registry.
>
> **Recommendation 7:** Consider a pilot project built on an existing blockchain, e.g., Ethereum, for a blockchain-based land registry in the state of Lagos and the FCTA. Use MVP built as a
>
> (1) Permissionless blockchain
> (2) Incorporates gatekeeper roles reflecting extant property law.

Based on stakeholder interviews, software development and testing, and extensive desk-based research on blockchain adoption for enhancing government services in developing countries between April – September 2023, the above-mentioned recommendations have been set forth. This White Paper also lays out a plan for the proposed pilot project in Lagos Land Registry (Recommendation 7) and links it to the work of the Steering group on Blockchain adoption at NITDA. A detailed analysis of sustainable development issues has aided the framing of this plan.

The research team invites stakeholders from the governance, development, and blockchain sectors to comment and engage with these recommendations and to feedback. The research team continues to discuss and analyse the best model of blockchain adoption for Nigeria and similar countries, through testing their minimum viable blockchain product for land administration and stake holder engagement. The team aims to develop a Green Paper in conjunction with implementing agencies in Nigeria.

[1] The name Nigereum has been used here for the purpose of convenience and not as a nomenclatural stricture.

Contents

In the moment of crisis, the wise build bridges, fools build dams.

- West African Proverb

1. Introduction

Blockchain technology holds promise for improving public services and brings opportunities for socioeconomic development in developing countries[2]. In Nigeria, blockchain technology got off on the wrong foot, and for a time, became a villain of the state. From the ENDSARS movement which was a response to criminalising youth carrying a crypto exchange app on their phones[3] to the Central Bank of Nigeria refusing to recognise bitcoin,[4] Nigeria's government resisted blockchain technology. However, with support from the blockchain community in Nigeria, the last few years has seen the government decoupling blockchain technology from crypto currency, resulting in the adoption of the National Blockchain Policy in May 2023.[5]

Nigerians will continue to undoubtedly use and benefit from blockchain technology as they are currently doing, i.e., through cryptocurrencies[6]. But for blockchain to bring wider socioeconomic development to Nigeria requires clear policy direction, timely well-researched interventions, combining knowledge and analysis from the fields of development, human rights, technology adoption models and governance research. Therefore, this research focuses on these areas. It studies the implications of blockchain for Nigeria's development and human rights fulfilment, through the adoption of blockchain technology for public services, commencing with land administration services. Nigeria's commitment to the global Sustainable Development Goals and the African Agenda 2063 requires it to pursue reform in its public services to build a prosperous country based on inclusive growth and sustainable development. Therefrom, the research that underpins this White Paper's recommendations considers two key questions,

1. Is blockchain technology suitable for land administration, i.e., can it give full effect to Nigerian Land Law and implement it more efficiently?
2. Can aspects of the *Right to Development* be 'designed-in' into blockchain for land administration?

The area of focus for this research is Lagos state. Land laws are peculiarly local and closely aligned to plural legal systems, including customary, 'English' (i.e., colonial) and state laws. Therefore, choosing a specific state for the test blockchain and related design analysis can properly take account of legal and spatial specificities of a specific jurisdiction.

This White Paper (WP) is structured as follows. Section 2 elaborates on the research design of this project and gives an indication of the nature of the issues raised in this WP. Section 3 of this Paper addresses the extant policy in Nigeria by tracing the shift in attitude towards this technology and the consequent new regulatory measures required to derive benefit from this policy. Section 4

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[2] A.G. Awolaja, Land registration in Nigeria: Issues, challenges Covenant Journal of Research in the Built Environment, 2(2): 176-194, April, 2016; Obamehinti Adeolu Seun *et al.,* Blockchain Technology for Managing land Titles in Nigeria, International Journal of Advanced Trends in Computer Science and Engineering, 9(4), July – August 2020, 5411 – 54

[3] Yomi Kazeem (October 26, 2020), *How Bitcoin powered the largest Nigerian protests in a generation.* Quartz. https://qz.com/africa/1922466/how-bitcoin-powered-nigerias-endsars-protests accessed 22- 6- 2023.

[4] Tofe Ayeni, (December 16, 2021) *What's behind the Central Bank of Nigeria's war on cryptocurrencies?* The Africa Report. https://www.theafricareport.com/157367/whats-behind-the-nigerian-central-banks-war-on-cryptocurrencies/ accessed 22-6-2023.

[5] NITDA, (May 2023) *National Blockchain Policy of Nigeria* https://nitda.gov.ng/wp-content/uploads/2023/05/National-Blockchain-Policy.pdf accessed 13-5-2023.

[6] https://www.forbes.com/sites/abubakarnurkhalil/2023/03/01/nigerian-election-and-naira-crisis-is-fueling-bitcoin-adoption/?sh=1c1a937135d4 accessed 21 Aug 2023

considers blockchain for land administration. Sections 5 and 6 explore a blockchain designed to achieve non-discrimination, social justice, and equitable development. Sections 7 and 8 envisage implementation a programme of work for blockchain land administration in Abuja and Lagos, conceptualising it as a continuum from the current initiatives in digitisation of the system.

This WP is the first of a series of outputs on blockchain policy in Nigeria, planned over 2023-2024, by the research team. It serves as a primer for proposals for statutory and regulatory measures around blockchain technology for land administration in Nigeria.

2. Research Rationale - Blockchain in Malaysia and Nigeria

The University of Hertfordshire's central QR Fund for research collaboration and impact devolved funds to foster multidisciplinary research into aspects of the global economy that relate to the disciplines taught and researched at the University. Using this Fund, Hertfordshire School of Law, and the School of Physics, Engineering and Computer Science at the University of Hertfordshire, in conjunction with the Multimedia University, Malaysia embarked on a research project to address various aspects of Blockchain technology. Three different sub-projects were envisaged at Hertfordshire: - 1. Blockchain adoption into Nigeria (the B-CAN project), 2. Technology adoption in developing countries (the RtD-TAM project), and 3. Development of a Minimum Viable Blockchain Product for Land Administration in Nigeria (the B-CAN-T project). The project uses a novel mixed methods approach to its research using -

1. doctrinal research
2. socio-legal research
3. product development

Existing literature show several emerging ideas for the regulation of cryptocurrencies[7] and some emerging ideas on smart contracts for land administration.[8] However, there is no research on blockchain as a tool for socio-economic and sustainable development. Current research urges land administrators to refrain from applying blockchain technology to land administration.[9] This research acknowledges the reasons for criticism of blockchain from a development perspective, and designs solutions for the same. It also takes a broader view of development, i.e., job creation through technology adoption, combining it with assessing the potential risks for the fulfilment of the Right to Development and SDGs. This approach allows it to critically analyse sovereign policies of large developing countries such as Nigeria,[10] whose sovereign approach to development is directed at all strata of society, i.e., those below the poverty line, as well as those relatively well off, considering a broader spectrum of economic inequality than the SDGs.

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[7] The Fifth EU Anti-Money Laundering Directive, People's Bank of China's Financial Distributed Ledger Technology Security Specification, European Union Blockchain Observatory and Forum's report *Legal and Regulatory Framework of Blockchains and Smart Contracts,* Federal Reserve Bank of Malta Financial Services Authority (MFSA) US State of Boston's Guidelines on Cybersecurity Measures, are some of the key examples.

[8] Ellul, J., Galea, J., Ganado, M. *et al.* Regulating Blockchain, DLT and Smart Contracts: a technology regulator's perspective. *ERA Forum* 21, 209–220 (2020). https://doi.org/10.1007/s12027-020-00617-7

[9] Cadasta Foundation, 'Blockchain for Land Administration: Hype or Substance?' https://cadasta.org/blockchain-for-land-administration-hype-or-substance/ accessed 24-6-2023.

[10] Federal Ministry of Communications and the Digital Economy (2019) National Digital Economy Policy and Strategy (NDEPS): 2020-030; Policymaker interview, on record with the authors. https://ngea.gov.ng/Content/resources/DTTWG%20Training_National%20Digital%20Economy%20Policy%20and%20Strategy.pdf accessed 23 Aug 2023

The B-CAN (Blockchain Adoption in Nigeria) project investigated seven research questions.

1. What are the different types of blockchain software in use where physical assets are linked to the blockchain? What types of techno-economic and political environments do they operate in?
2. What are the concrete steers for the National Blockchain Adoption Policy for land administration in Nigeria. Can this be developed?
3. Can Nigerian real estate adopt coloured coins, and fulfil Articles 11 and 12 of the Draft Convention on the Right to Development (DCRD)?
4. Does the 'duty to cooperate' (under DCRD) necessitate sharing technology at low cost?
5. How does low resource footprint blockchain sit with Nigeria's (2015) Paris Agreement NDC (Nationally Determined Contribution) plan?
6. Can a model blockchain/coloured coin be developed for a section of LAS (Land administration system), fulfilling third generation human rights, while complying with first- and second-generation human rights?
7. Is blockchain a threat to the exercise of territorial sovereignty by a state through hijacking (decentralisation) of LAS?

The RtD- TAM (Right to Development – Technology Adoption Model) project considered the following questions.

1. Can a human rights-based impact assessment (HBIA) model for technology be created to assess fulfilment of the Right to Development through technology adoption for development problems?
2. Can a business studies theory be applied in development studies to derive a HBIA-Tech? Can the theory of TAM (Technology Adoption Model), be used for creating HBIA-Tech for developing countries?

The B-CAN-T (Blockchain Adoption in Nigeria - Testing) project set out to address the following tasks.

1. To develop a Minimum Viable Product (MVP) for land administration using blockchain
2. To test the system with users from various sectors related to land admin in Nigeria.

A research team from Hertfordshire Law School conducted field research in Lagos from 3rd -17th June 2023, talking to key policymakers and stakeholders in Lagos and Abuja, using a semi-structured interview approach. The WP incorporates insights gained from the interviews.

3. The National Blockchain Policy of Nigeria

The National Blockchain Policy of Nigeria was drafted by the National Informational Technology Development Agency (NITDA) which is responsible for the development of information technology in Nigeria. NITDA released its Blockchain Policy in May 2023,[11] with the intention of developing an implementation strategy in due course via a Steering Committee.

The Blockchain Policy of 2023 is divided into four main sections focussing on the benefits of blockchain, the key areas of focus, the outcomes of successful adoption, and the implementation

[11] *supra, fn.5*

structure. The benefits envisaged are that blockchain technology would be a catalyst for innovation and economic growth, enabling the development of new business models, products, and services that will lead to job creation. The government can attract investment, promote research and development, and foster entrepreneurship, it can also enhance public trust in governance and promote citizen engagement by increasing transparency and accountability. The key areas of focus include talent development, innovation, and adoption. The focus area of talent development is comprehensive but vague. It ranges from training and certification programmes, through to encouraging Blockchain professionals to develop and sustain the Nigerian Blockchain industry, and to develop research and development programmes to promote innovation in the Blockchain industry. The innovation strategy is highly ambitious. It includes collaboration with private sector, academia and other research institutions, creation of regulatory sandboxes where Blockchain Start-ups can test their innovative ideas without being subject to stringent regulations, thus promoting innovation while also ensuring consumer protection and market stability; and collaboration with international organisations to promote innovation in the Blockchain industry. The policy envisions the adoption of blockchain in the following sectors - identity management, land registration, supply chain management, intellectual property, and voting systems.
The outcomes section of the Blockchain policy relate to outcomes in all areas of focus, closely linking the two, aiming to deliver an increased number of blockchain startups, increasing international collaboration, and blockchain-friendly regulatory frameworks. An important section of the policy is the implementation section which outlines the key actors in the next steps for this policy. The implementation is led by a Steering Committee consisting of 29 agencies and organizations, which includes several federal ministries, central bank of Nigeria (CBN), the Securities and Exchange Commission (SEC), the Nigerian Governors' Forum (NGF), Stakeholders in Blockchain technology in Nigeria SiBan, Fintech Association of Nigeria, Nigerian Universities Commission, the Federal University of Technology, Minna, the Federal University of Technology, Akure, Domineum Blockchain Solutions Ltd, Baze University Blockchain Experience Centre, and Paystack Payments Limited.

Overall, the national policy for blockchain in Nigeria consists of the highest ambitions. The processes that will bring about flesh to the bones of this policy need to be considered and assessed in due course.

The next section considers the role and powers of the body that has brought about this pioneering policy.

3.1 Significance of the National Blockchain Policy

This section considers the concept of co-creation in rulemaking, an innovation in the rule making processes of the National Informational Technology Development Agency (NITDA). Interviewing various officials at NITDA made it clear that this new process, established in 2017, had aided the formation of an open, progressive policy on blockchain, leading away from views of sceptics within government about the negativities surrounding blockchain because of its conflation with cryptocurrencies.

Originating in 2017, the NITDA *Rule Making Process Regulation* contains procedural transparency and participation required of modern governance.[12] The 2017 Regulation introduces co-creation. Co-creation requires the engagement of a wider set of stakeholders in the area sought to be regulated. Rules can originate from a wide range of sources, including even a member of the public.[13] The 2017 Regulation states that the 'Agency may receive a proposal from an Originator in writing, through any media, to develop any Rule subject to the provisions of this Regulation. Such Originator may include but not limited to the following: (a)professional bodies; (b)Industry Stakeholders; (c) Commissions or Agencies; (d) Advisory Committees; (e) Any Department of the Agency; or (f) Any member of the Public'. The consequence of this is that NITDA's engagement strategy is wide, even though it is doubtful if any member of the public has indeed ever been the Originator of a rule. Section 8 lays out priorities for rule making, and this includes new technologies, thus facilitating blockchain rule making a priority. The process leads into stakeholder engagement session within Nigeria and the formation of a joint committee including the Originator, the stake holders, and the Agency. It is an interesting process in that the ownership of the rule could potentially be equally shared with non-agency stakeholders. The rule making process could potentially lead to robust rules in the regulation of blockchain. The recommendations made in sections 4 and 5 of this WP can be progressed through the co-creation process.

Nigeria's National Blockchain Policy should be read alongside this important institutional feature of NITDA. The policy is an outcome of co-creation processes required by NITDA's mandate for policy. The development of the forthcoming blockchain strategy should also be contextualised within this innovative co-creation-based rule making process. The pros and cons of this WP's recommendations can be successfully discussed only if a collaboration between law makers and technical specialists, which the co-creation processes facilities, materialises. Blockchain as a technology is seen as a threat to state institutions[14]. To bridge this gap, co-creation is a welcome method of engagement.

In addition, some other initiatives of NITDA will also have an impact on the implementation of the blockchain policy. NITDA sponsored Data Protection Act 2023, NITDA's internal policies on inclusivity of gender, disability etc, and its evolving environmental sustainability policies will play a role in the forthcoming implementation strategy.

3.2 NITDA's regulatory powers

NITDA has a regulatory role, with powers to recommend legislation to regulate blockchain technology. Building on the outcomes of the co-creation process of rulemaking, NITDA can recommend primary legislation as well as secondary legislation. Under sec. 6 (a) of the NITDA Act 2007,[15] the agency functions for 'monitoring, evaluation and regulation of Information Technology practices, activities and systems in Nigeria'. In addition, it has a specific development remit to provide 'universal access for Information Technology and systems penetration including

[12] The Rule Making Process Regulation of NITDA 2017, National Information Technology Development Agency Act 2007 https://nitda.gov.ng/wp-content/uploads/2020/11/The-Rule-Making-Process-Regulation-of-NITDA1.pdf accessed 23-6-2023

[13] Part Three, Section 7, The Rule Making Process Regulation of NITDA 2017

[14] Atzori, Marcella, Blockchain Technology and Decentralized Governance: Is the State Still Necessary? (December 1, 2015). Available at SSRN: https://ssrn.com/abstract=2709713 or http://dx.doi.org/10.2139/ssrn.2709713

[15] National Information Technology Development Agency Act 2007 Act No. 28, Federal Republic of Nigeria Official Gazette No. 99. Vol. 94, Lagos. (5th October 2007)

rural, urban and under-served areas.' The regulatory function of guiding technology development stands alongside the duty to promote equality of access to technology. As per sec. 6 (k), it acts to 'determine critical areas in Information Technology requiring research intervention and development in those areas,' and under sec 6 (l), NITDA is charged with 'advice(ing) the Government on ways of promoting the development of information technology in Nigeria including introducing appropriate information technology legislation.' This WP lays out a set of recommendations for new primary legislation on blockchain core developer responsibilities and capacity building, which will require the exercise of these powers.

NITDA's powers, commensurate to its functions, seems limited. Section 7 (a) endows the NITDA Board with powers to formulate overall policy for the management of the affairs of the Agency, and only residual powers under s.7 (e) 'Exercise such powers as are necessary of expedient for giving effect to the provision of this Act' could well enable its function to advice on regulation required for new and emerging technologies. To regulate blockchain is challenging[16] because, by definition, blockchain enables new forms of social and community co-operation without a central authority, offering the promise of decentralising and democratising collective decision-making.[17] To be able to find the balance between these two ideologies will be the role of any regulator. The recommendation for a new blockchain for Nigeria's public services is being advanced for this reason. The creation of a new blockchain allows the state to control the level of decentralisation that is found acceptable to the state, without a loss of sovereignty.

It is possible, with the combination of NITDA's co-creation and regulatory powers, the challenge of effectively harnessing the potential of blockchain technology for the economic and sustainable development of Nigeria is well within reach.

Several, if not all the recommendations in this White Paper, can be sown as regulatory policies because of the enabling powers of NITDA.

Recommendation 1, to launch Nigereum – a new blockchain for Nigeria will fall within the remit of NITDA, under sec. 6 (k) 'to determine critical areas of IT requiring research intervention and development'. Sec. 6(l) will facilitate recommendations 3 and 5 – legislation on core developer responsibilities and a Data Embassy Agreement. To activate recommendations 2 and 6, sec. 7(e) will enable co-operation between the Central Bank of Nigeria and NITDA to consolidate e-Naira on Nigereum, and to support Lands Bureau with the software support required for STDM. sec. 7 (a) enables NITDA overhaul its Blockchain policy as suggested in recommendation 4, focussing on strategic capacity building towards creating Nigereum.

The later sections will provide the analysis behind the recommendations.

3.3 Blockchain technology and the public in Nigeria

Blockchain technology in Nigeria, in the popular imagination, is associated with cryptocurrency and the refusal of the Central Bank of Nigeria to approve its use in Nigeria. This has, to a large extent, conflated blockchain technology, with cryptocurrency in Nigeria. However, there is also a different story to tell with regards to crypto currency in Nigeria, and consequently the perception

[16] De Filippi, Primavera. "Bitcoin: a regulatory nightmare to a libertarian dream". Internet Policy Review 3.2 (2014). Web. 21 Aug. 2023.

[17] Yeung, Karen. 'Regulation by Blockchain: The Emerging Battle for Supremacy between the Code of Law and Code as Law'. *Modern Law Review*, vol. 82, no. 2, 2019, pp. 207–39.

of blockchain technology in the country. In a survey conducted by Statista,[18] Nigeria ranks number one globally as the leading country per capita for Bitcoin and cryptocurrency adoption, with nearly one-in-three Nigerians indicating they used or owned crypto assets in 2020. In 2023 this figure has further risen, and 47% of the respondents from Nigeria stated that they owned or use a digital coin.[19]

Several factors culminate in creating positive conditions for the uptake of crypto currencies in Nigeria, and these include the relative youth of the population, the already existing peer to peer online payment systems through mobile phones, and the uncertainty and volatility in the official currency. More than 50% of Nigeria's population falls into the under-30 age group. Crypto currencies are used daily to pay in store as well as to send money to friends and family. So, use of blockchain underlined technology is more frequent than one might imagine. In Nigeria, it may be used not just as an investment tool, but also as a day-to-day transactional tool.

Perception of blockchain technology has two sides. It is embraced by millions of Nigerians, but it is perceived with caution and reluctance in governance circles in Nigeria. This is set to change, with the introduction of the National Blockchain Policy in May 2023. The scope for widening application of blockchain technology is part of this policy, and it may well be embraced by the public given that they are aware of the benefits of the technology in their daily lives already.

The stage is set, with public acceptance, and as official policy on blockchain technology, to apply blockchain technology on a wider scale, for a wider range of applications. The next section will consider the relevance of blockchain technology for land administration.

4. Blockchain for Land Administration

The relevance of blockchain for Land Administration is considered in two parts in this research. First, the benefits reported in secondary literature on this subject, and second, the benefits perceived by respondents to our interviews, drawn from policy makers, property law practitioners, and researchers in Nigeria.

In reviewing the use of technology for land administration systems (LAS), the literature suggests three discrete areas of land administration - (1) Support for Land Tenure Enabling Environment, (2) Land tenure Data Collection and Aggregation and (3) Formal land Titling.[20] This can be further broken down into the following applications: (a) title deed registration; (b) time-stamped transactions; (c) multi-party transparent governance tools; (d) tamper proof recording system; (e) disaster recovery system; and (f) restitution and compensation in post- conflict zones. Recent research has shown that application of technology in all these three areas is still at 'a basic level,

[18] Victor Oluwole (Aug 13, 2021) *Nigeria is the leading country per capita for Bitcoin and cryptocurrency adoption in the world – report,* https://africa.businessinsider.com/local/markets/nigeria-is-the-leading-country-per-capita-for-bitcoin-and-cryptocurrency-adoption-in/drv4121 accessed 23-6-2023

[19] Raynor D. Best (Jun 15, 2023) Cryptocurrency adoption in 56 different countries worldwide 2019-2023, https://www.statista.com/statistics/1202468/global-cryptocurrency-ownership/ accessed 23-6-2023

[20] Reynolds, T. W., Anderson, C. L. Biscaye, P., Callaway, K., Chen, K., McDonald, M., & Morton, E. (2017). Land tenure technologies: Summary of services and implementation (EPAR Technical Report No. 357). Washington, DC: Evans School Policy Analysis and Research (EPAR).

manual and labour intensive' in Nigeria.[21] Direct contact is still the dominant way for accessing the institutions and processes of land administration, with only a small percentage done online (9.4 %) and with the vast majority of actors being males.[22] The use of technology in Nigerian land administration can be traced back to the 1980s when computers were brought in for internal information management, followed by online information services about LAS procedures for the wider public in the 1990s, and moving to more intense use of computerisation/digitisation[23] through the introduction of e-registration of title in 2003.

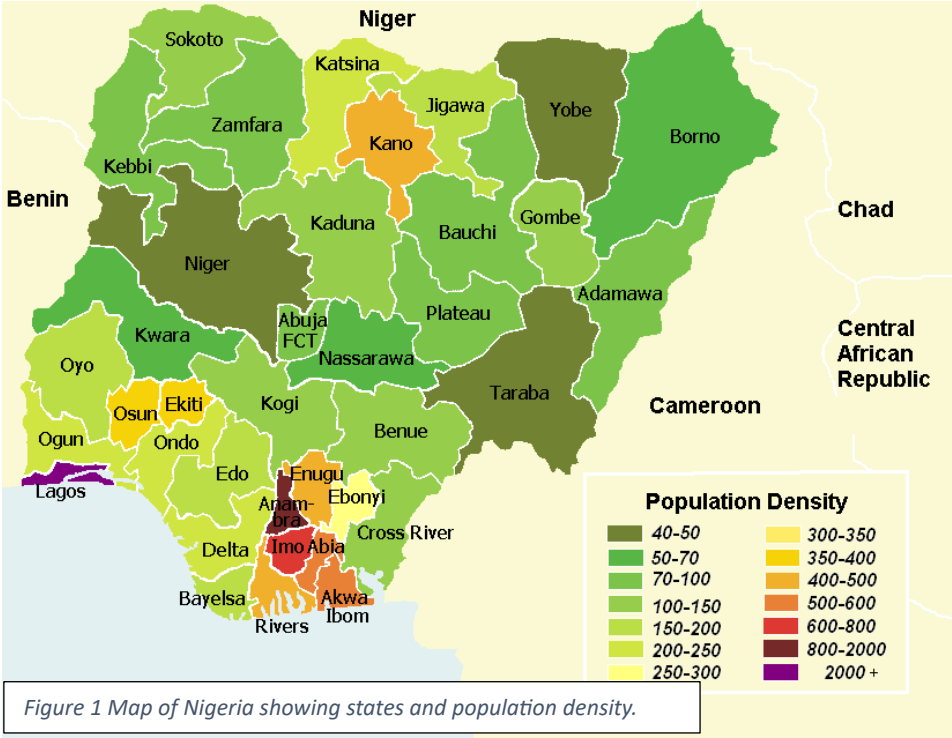

Figure 1 Map of Nigeria showing states and population density.

However, these measures were not uniform throughout the country. Regions differed in the nature of ownership of land holdings. The northern regions differed from the southern and western regions, and there was more technology-aided LAS in Lagos, Kaduna, Niger, and Abuja.[24] In considering blockchain for land administration in Nigeria, the current state of technology adoption in land administration is relevant, as it determines whether blockchain would be successfully absorbed as part of land administration.

The technology that has made most strides in LAS is geospatial information systems (GIS). This has improved cadastral accuracy, resolved uncertain boundaries, and provided clearer delimitation of different types of land. This technology continues to revolutionise LAS and is delivering benefits as is evident from the recently convened built environment stakeholders meeting in Lagos state.[25] The Surveyor General of the state, whose office is responsible for the

[21] Tosin B. Fateye, Ayodele A. Ibuoye , Babatunde M. Wahab , Victoria O. Odunfa (2020) Technological Innovations in Land Administration System (LAS): Concern on Level of Awareness in Nigeria, International Journal of Real Estate Studies, 14:2, 140-155 | www.utm.my/intrest | e-ISSN: 2231-7643

[22] Hosaena Ghebru and Austen Okumo (2016) Land Administration Service Delivery and Its Challenges in Nigeria, International Food Policy Research Institute, Working Paper 39.

[23] Editor (26 July 2021) *Edo deploys technology to improve land management, ease registration,* https://guardian.ng/news/edo-deploys-technology-to-improve-land-management-ease-registration/ accessed 24-6-2023

[24] *supra fn.20*

[25] Gbenga Salau (17 Dece 2022) Adegboruwa tasks Lagos on technology to improve land management, https://guardian.ng/news/adegboruwa-tasks-lagos-on-technology-to-improve-land-management/ accessed 24-6-2023.

issuance of land information certificates, charting information, certified survey plans and preparation of composite plans, identified GIS as one of the needs of 21st century land management in the country. He also pointed out that the need of the hour was 'a more cordial relationship among stakeholders, investors and regulators,' 'to discuss issues resulting from the rapid growth of the urban population in Lagos State and how the development of geospatial information could address the identified problems.'[26] Blockchain was conspicuous by its absence in this discussion. It is partly because of the newness of the technology, but also partly as the land administration system may not have a pressing need for it.

However, blockchain is not so unknown to LAS professionals in Nigeria. Out of a list of 35 technologies surveyed among LAS officials, blockchain ranked as twenty-second the in order of technology awareness among LAS professionals.[27] What is clear is that blockchain is within the radar of technologies known to LAS professionals and may eventually be adopted. Global literature in this area is cautious in the utility of blockchain for land administration.[28] Looking at existing examples of blockchain adoption in various jurisdictions, two key observations can be drawn. Where there is a system of conclusive titling as part of the land administration system, blockchain technology can help speed up processes, decentralise and thereby lead to gains in the land economy. Where there operates a system of non-conclusive titling, blockchain can succeed provided there is a technically advanced registry with a cadastre that has near-universal coverage of the jurisdiction. Such a jurisdiction is a good fit for blockchain as it can expect an incremental improvement in transparency and security of transactions because of blockchain application. However, if there are issues of governance, compounded by a lack of data and transparency, these result in insecure land rights – not due to systems that are not secure, but because of a lack of recording and equitable recognition of rights.[29] A technological product cannot resolve a pre-existing institutional malaise, including lack of transparency, corruption, and lacking accountability. [30]

In Nigeria, the latter seems the case, issues of governance and insecure land titles are notable. Fundamental gaps in the rule of law exists, with Nigeria ranking 118 out of 140 in the 2022 Rule of Law (RoL) Index, which assesses regulatory enforcement, civil justice, absence of corruption, among other factors.[31] Therefore, it is important to identify appropriate tools for land administration.[32] It is possible that elements of the blockchain technology, instead of the whole technology, can be utilised for land administration purposes. In Singapore, a jurisdiction which

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[26] *ibid*

[27] Tosin B. Fateye1, Ayodele A. Ibuoye , Babatunde M. Wahab , Victoria O. Odunfa (2020) Technological Innovations in Land Administration System (LAS): Concern on Level of Awareness in Nigeria, *International Journal of Real Estate Studies*, 14:2, 140-155 | www.utm.my/intrest | e-ISSN: 2231-7643

[28] Shivani Nayyar (2018) Blockchain technology for human development: Not so fast? UNDP Reports. https://hdr.undp.org/content/blockchain-technology-human-development-not-so-fast accessed 24-6-2023.

[29] *Ibid*

[30] Eder, George Jackson and George Jackson Eder. "Digital Transformation: Blockchain and Land Titles." (2019) OECD Paper

[31] WJP (2022) *Overall Index Score*, https://worldjusticeproject.org/rule-of-law-index/country/2022/Nigeria/ accessed 24-6-2023.

[32] TS 9A – Development of Land Tenure Systems – Developing Countries 2/14, UKAEJIOFO Andrus Nnaemeka, Identifying Appropriate Tools for Effective Land Governance in Nigeria (4612), FIG Congress 2010, Facing the Challenges – Building the Capacity, Sydney, Australia, 11-16 April 2010

embraces e-government quite widely, the OpenAttestation OA App securely stores and enables quick verification of important documents, without the need for a centralised authority or intermediary.[33] This is a blockchain application for just part of the process in a unit of land administration. The Blockchain policy in Nigeria however envisages a fuller blockchain application in land administration, i.e., a blockchain-based land registry. NITDA has identified this use case for blockchain based on the importance of land transactions for the public, and the number of delays faced through the current business processes, which include checks and balances built in for security and certainty of title, but which also contributes to the extraordinary red tape, bureaucracy, and a culture of 'greasing the elbow,' (a euphemism for bribery) that characterises LAS in Nigeria. Blockchain is amenable for registries, as it enables a secure and 'distributed ledger'. Therefore, the land register, a ledger of records, is a natural fit for blockchain is. The identification of this particular application of blockchain in land registry systems is supported by the literature on blockchain. One research even suggests the uptake of blockchain technology could help resolve up to about 85% of the land challenges in Nigeria.[34] This could give a real boost to Nigeria's current World Bank ranking of 131 in the list of 190 countries for its ease of doing business, i.e., protection of property rights.[35]

4.1 Digitisation and the Land Administration System

One key area of policy identified by policy makers and researchers during our interviews was digitisation of land administration. Transparency and speed are the key problematic issues for land administration in Nigeria. Digitisation is intended to improve both aspects. However, the progress of digitisation in Lagos was contested by users. While digitisation is said to be at an advanced stage by the executive, observers and users do not believe this to be the case, as the public-facing portal for digitised documents is yet to materialise. The stage of completion of digitisation of documents is relevant to blockchain adoption, and electronic documents are an essential part of the process of blockchain adoption. Without full digitisation, blockchain cannot function.

Digitisation needs to produce digital records that are fit-for-purpose for blockchain technology to use. Therefore, the executive leadership, management, and operation officers in the Land Registry and other relevant sections of the Lands Bureau should open conversations now with blockchain technologists and decision-making powers on compatibility of current digitisation protocols with the blockchain protocol. With digitisation, there are two issues – one is where paper records are available, but they are not digitised. Another is where paper records are not available, i.e., there is instability in recognition of rights over land. This section merely touches on the issue of digitisation where paper records exist. A later section will address the issue of lack of recognition of rights through a solution called the SDTM – a socially co-created title system, which directly records rights digitally. It uses a combination of geospatial and simple programmes like Excel and Word, all rolled into one system – SDTM.

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[33] Singapore Government Developer Portal, https://www.developer.tech.gov.sg/products/categories/blockchain/openattestation-wallet-app/overview.html accessed 23-6-2023

[34] Ibrahim, Isyaku and Daud, Dzurlkanain and M. Azmi, F. A. and M. Noor, N. A. and M. Yusoff, N. S. (2021) *Improvement of land administration system in Nigeria: a blockchain technology review.* International Journal of Scientific & Technology Research, 10 (8). pp. 33-39. ISSN 2277-8616

[35] World Bank (2019) *Ease of Doing Business* (since discontinued) https://data.worldbank.org/indicator/IC.BUS.EASE.XQ accessed 24-6-2023.

Nigeria's technology sector is rapidly becoming a major economic sector in Nigeria, even overtaking the contribution of the oil and gas sector. Therefore, as a significant economic sector, it has the responsibility to deliver development benefits too. The next section of this report delves into more detail in the social justice, equality, and development benefits that blockchain could potentially bring.

5. Unlocking the 'Development Potential' of Blockchain Technology

In the field of development studies, Development is defined as when a country experiences a reduction or elimination of poverty, inequality, and unemployment.[36] All of the policies of developing countries can be viewed through this lens, as aiming to reduce poverty, inequality, and unemployment. And yet, a reader of the blockchain policy of Nigeria would not get the impression that blockchain adoption in Nigeria is meant to address any of these issues. Throughout the 30 pages or so of the policy document, there is no mention of strategies to reduce poverty and inequality. In fact, the document reads like, and uses words of a policy in a developed economy. The ambition to develop new business models, products, and services that will lead to job creation, attracting investment, promoting research and development, and fostering entrepreneurship, all point to thinking detached from some hard ground realities in Nigeria. This section of the White Paper aims to contextualise the national blockchain policy within development and considers specific policies to unlock the development potential of blockchain technology. In suggesting specific 'development-led' interventions for blockchain implementation in land administration, it aims to acquire for NITDA's blockchain policy, a social license to operate in Nigeria.

Blockchain is expensive technology. Its set-up takes up a large amount of capital, which it may pay back in due course. But funnelling precious resources set aside for land administration into developing a blockchain-based registry will be seen as diverting resources from all the pressing needs of the land administration system in Lagos, as well as in the rest of Nigeria. Financing for development is a crucial area for development and is perpetually underfunded. Therefore, a development-sensitive adoption of blockchain for land administration can serve as a full and robust justification for blockchain as a solution in land administration in Nigeria.

The Land Use Act, which is directly sanctioned through the Constitution necessitates this, and it supports the adoption of technology for the prosperity of the nation. The Land Use Act formerly called the Land Use Decree No 6 of 1978 was promulgated by General Olusegun Obasanjo's regime on 29 March 1978, and its status as a key legislation for the country is cemented in Section 315 (5) of the Constitution of the Federal Republic of Nigeria which provides:

"Nothing in this Constitution shall invalidate the following enactments, that is to say –

(a) the National Youth Service Corps Decree 1993
(b) the Public Complaints Commission Act
(c) the National Security Agencies Act
(d) the Land Use Act."

[36] Seers, D. (1969) The Meaning of Development, IDS Communication 44, Brighton: IDS

The Constitution provides in Chapter II Fundamental Objectives and Directive Principles of State Policy Article 16 (1) (a) that 'the state shall harness the resources of the nation and promote national prosperity and an efficient, dynamic and self-reliant economy.'

Article 18 (2) Govt shall promote science and technology. The constitution of Nigeria addresses social justice, and inequality, alongside fostering the adoption of benefits of science and technology. In addition, Nigeria has undertaken international obligations related to human rights.

Nigeria is a leading member of the *African Charter of Human and Peoples' Rights* which states in Article 22

> 1. All peoples shall have the right to their economic, social, and cultural development with due regard to their freedom and identity and in the equal enjoyment of the common heritage of mankind.
>
> 2. States shall have the duty, individually or collectively, to ensure the exercise of the right to development.

This applies in domestic law via the *African Charter on Human and Peoples' Rights (Ratification and Enforcement) Act*. As a leading African nation in the Food and Agriculture Organisation, Nigeria has endorsed 2012 *The Voluntary Guidelines on Responsible Governance of Tenure of Land, Forests and Fisheries (VGGT),* the only comprehensive international declaration on governance of land, a key sovereign domain. VGGT sets out standards for countries in relation to governance of tenure on land, and its standards of responsibility apply to any new technology adopted within the land administration systems in Nigeria.

Nigeria is a signatory of the Paris Agreement 2015 for net zero by 2050,[37] and a member state of the United Nations Framework Convention on Climate Change (UNFCCC). As part of its obligations under the Paris Agreement 2015, Nigeria submitted what's known as 'Nationally Determined Contribution' in 2022, and in it, the government states.

'Nigeria, Africa's largest economy, has a key role to play in delivering the aims of the Paris Agreement in the continent of Africa. Today, one fifth of Africans, some 200 million people, are Nigerians. The World Bank projection is that Nigeria that will become the world's third most populous country by 2050 with over 400 million people. As a country that is both highly vulnerable to the impacts of climate change, and also one of the largest emitters across Africa, Nigeria has an important leadership role to play.' The economic fundamentals and development priorities haven't changed since 2015; diversification of the economy and growth in non-oil revenue are essential to job creation by MSME's, especially for youth.'[38]

Following up on the NDC, it has formulated its Long-Term Low Emission Development Strategy (LT-LEDS) led by the Nigeria Deep Decarbonisation Project and is looking set to keep on the long-term trajectory of CO2 equivalent emissions reductions in all sectors of the economy[39].

Being obliged by the above-mentioned national and international law to comply with social justice and climate justice laws, the adoption of blockchain has to:

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[37] Fankhauser, S., Smith, S.M., Allen, M. *et al.* The meaning of net zero and how to get it right. *Nat. Clim. Chang.* 12, 15–21 (2022). https://doi.org/10.1038/s41558-021-01245-w

[38] UNFCCC (2022) 'Nationally Determined Contributions – Nigeria' https://unfccc.int/documents/497790 accessed 26-6-2023.

[39] Fabian Ekeruche (16 June 2023) *Climate Policy: Expert Hails Contributions of Nigerian Academics* https://sppnigeria.org/climate-policy-expert-hails-contributions-of-nigerian-academics/ accessed 20-07-2023.

1. not have a negative impact on social and climate justice
2. strive to have a positive impact on social and climate justice.

6. 'Designing-in' development benefits into blockchain

Adopting blockchain for land governance will require reliable, stable, and accurate data. It is a key requirement for blockchain. In Nigeria, as in many developing countries, land data is unstable, with large gaps in records and disputes surrounding land ownership, marked by insecure tenure arrangements. This is the main reason behind the formulation of Part 5 of the 2012 *Voluntary Guidelines on Responsible Governance of Tenure of Land, Forests and Fisheries (VGGT),* which states:

17.1 States should provide systems (such as registration, cadastre and licensing systems) to record individual and collective tenure rights in order to improve security of tenure rights, including those held by the State and public sector, private sector, and indigenous peoples and other communities with customary tenure systems; and for the functioning of local societies and of markets.

17.2 States should provide recording systems appropriate for their particular circumstances, including the available human and financial resources. Socioculturally appropriate ways of recording rights of indigenous peoples and other communities with customary tenure systems should be developed and used. In order to enhance transparency and compatibility with other sources of information for spatial planning and other purposes, each State should strive to develop an integrated framework that includes existing recording systems and other spatial information systems. In each jurisdiction, records of tenure rights of the State and public sector, private sector, and indigenous peoples and other communities with customary tenure systems should be kept within the integrated recording system. Whenever it is not possible to record tenure rights of indigenous peoples and other communities with customary tenure systems, or occupations in informal settlements, particular care should be taken to prevent the registration of competing rights in those areas.

17.3 States should consider using locally based professionals, such as lawyers, notaries, surveyors and social scientists to deliver information on tenure rights to the public.

17.4 Implementing agencies should adopt simplified procedures and locally suitable technology to reduce the costs and time required for delivering services. The spatial accuracy for parcels and other spatial units should be sufficient for their identification to meet local needs, with increased spatial accuracy being provided if required over time.

These are extremely pertinent provisions by which to assess the suitability of blockchain technology in land administration, as well the suitability of pathways or programmes of blockchain adoption. Other provisions of the VGGT also provide a very good framework for setting responsible governance standards for the adoption of blockchain technology for land administration. As the scope of a WP is limited, suffices to note that while writing the smart contracts for Nigereum the full range of VGGT provisions will need to be incorporated.[40]

SDG 1.4 also alludes to this same problem, when it sets the target by 2030, to 'ensure that all men and women, particularly the poor and the vulnerable, have equal rights to economic resources, as well as access to basic services, ownership, and control over land and other forms of property,

[40] *What is a Smart Contract?* https://www.coinbase.com/learn/crypto-basics/what-is-a-smart-contract accessed 19-10-2023.

inheritance, natural resources', and measures this using a data indicator 'Percentage of women, men, indigenous peoples, and local communities with secure rights to land, property, and natural resources, measured by (i) percentage with documented or recognized evidence of tenure, and (ii) percentage who perceive their rights are recognized and protected.'[41] It is noted that the achievement of SDG 1.4 in Nigeria is at high risk.[42]

Having established the importance of good data for governance, as well as for blockchain technology to operate, the process for 'designing-in' data solutions into blockchain adoption policy for land governance require designing of interventions to close this data gap. This research proposes STDM – Social Tenure Domain Model, as an intervention for acquiring quality land tenure data for blockchain.

6.1 Social Tenure Domain Model

The Social Tenure Domain Model (STDM) describes relationships between people and land in an unconventional manner in that it tackles land administration needs in hitherto neglected communities such as people in informal settlements and customary areas. It is a multi-partner software development initiative to support pro-poor land administration. The initiative is based on open-source software development principles. It supports development and maintenance of records in areas where regular or formal registration of land rights is not the rule.

This means informal rights such as occupancy, adverse possession, tenancy, use rights (this can be formal as well), etc. or customary rights, indigenous tenure, etc as well as the formal ones are recognised and supported (with regard to information management) in STDM enabled land administration system. Likewise, the STDM accommodates a range of spatial units ('where', e.g., a piece of land which can be represented as one point – inside a polygon, a set of lines, as a polygon with low/high accuracy coordinates, as a 3D volume, etc.). Similarly, the STDM records all types of right holders ('who', e.g., individuals, couples, groups with defined and non-defined membership, group of groups, company, municipality, government department, etc.).

In STDM enabled land administration, data coming from diversified sources is supported based on local needs and capabilities. This pertains to both spatial and administrative (non-spatial) data. For example, it may be, in informal settlements, sufficient as a start to relate people-land relationships to a single point. Then attributes such as photographs and fingerprints can be attached to the records. In a central business district (CBD) of a city, a traditional cadastral map/register may be required while in a residential area, land administration needs may entail using a map derived from satellite images and combined with formal descriptions of rights and right holders. The STDM encourages and caters for all these variations.

The STDM is integrated with the ISO-approved Land Administration Domain Model (LADM).[43] Currently SDTM is being used in East Africa, and in a few other parts of the world.

A point pertinent for discussion is whether blockchain for land administration needs to be paused while quality data is generated via STDM. To address this problem, a different development solution can be 'designed-in' - *Benefit-sharing*. If blockchain will bring benefits for the land economy

[41] https://indicators.report/indicators/i-5/ accessed 18-10-2023.
[42] Nigerian SDGs (2016) https://www.nigerianstat.gov.ng/pdfuploads/SDGs%20Nigeria_Final-1.pdf accessed 26-6-2023.
[43] https://stdm.gltn.net/ accessed 17-7-2023.

and its participants, then its adoption should not be paused. But that benefit can be shared with parts of the land economy where blockchain cannot be implemented straightaway because of lack of quality data. This thinking intrudes into the subject of the next part of this report on Implementation, where the disaggregated approach to blockchain adoption for land administration will be discussed in more detail. The next section will focus on the concept of *Benefit-Sharing.*

6.2 Benefit-sharing

Access and benefit sharing (ABS) is a concept in international law to address poverty and sustainable development. [44] ABS is a transactional mechanism designed to allow countries to trade access to their sovereign genetic resources for monetary and non-monetary benefits, with the goal of channelling those benefits into sustainable development.[45] While the concept of ABS was developed in the context of genetic resources, and between states, it can apply within states, and between different sections of society, so long as there are assets and potential for sustainable development. A blockchain ABS charge can be levied as part of the fees for use of the system in one area of Lagos, and the collected charges can go towards paying for the STDM scheme for securing better data coverage for blockchain in another area of Lagos (the same would apply in other states).

As the land economy has the potential to leap forward with the use of blockchain technology, it can potentially leave increased inequality in its wake. The landless have no stake in blockchain for land administration. But an ABS charge will create conditions for the tenure-insecure and those with illiquid land assets caused by lack of titles, to benefit from a STDM-Blockchain scheme for land administration. In time, this could also lead to land grants, which will eventually also benefit the landless.

6.3 Blockchain Carbon Footprint

A key concern in the blockchain industry is the carbon footprint or CO2 equivalent emissions caused by the various blockchains currently in operation.[46] The strength of the system is also its weakness when it comes to its carbon footprint. Blockchain is highly secure and tamper proof because of the number of nodes that operate to replicate and hold the data. But these multiple nodes, sometimes running into the hundreds of thousands[47], take huge amounts of energy to run Nodes are computers that process transactions on the blockchain, and which help sustain the blockchain.

In recognition of the significant carbon footprint left by blockchain and crypto currencies, the private sector, inspired by the 2015 Paris Agreement, took the initiative known as the Crypto

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[44] Grosse Ruse-Khan, Henning, The Private International Law of Access and Benefit-Sharing Contracts (November 1, 2017). In: C. Correa, X. Seuba (eds.), Intellectual Property and Development: Understanding the Interfaces, Singapore, Springer, 2019, pp. 315-375, University of Cambridge Faculty of Law Research Paper No. 52/2017, Max Planck Institute for Innovation & Competition Research Paper No. 17-14, Available at SSRN: https://ssrn.com/abstract=3070271 or http://dx.doi.org/10.2139/ssrn.3070271

[45] Eccleston-Turner, M., & Rourke, M. (2021). Arguments against the inequitable distribution of vaccines using the access and benefit sharing transaction. *International & Comparative Law Quarterly, 70*(4), 825-858. doi:10.1017/S0020589321000294

[46] Justine Calma (2021) *Could a Crypto Climate Accord erase cryptocurrencies carbon footprint?* https://www.theverge.com/2021/4/8/22373524/cryptocurrency-climate-accord-bitcoin-carbon-footprint accessed 21-07-2023.

[47] https://cointelegraph.com/learn/what-is-a-bitcoin-node-a-beginners-guide-on-blockchain-nodes accessed 19-10-2023.

Climate Accord (CCA) for the entire crypto community to focus on decarbonizing the cryptocurrency and blockchain industry.[48] The CCA's overall objective is to decarbonise the global crypto industry by prioritising climate stewardship and supporting the entire crypto industry's transition to net-zero greenhouse gas emissions by 2040. The two interim objectives that will help achieve this target by 2040 include, to achieve net-zero emissions from electricity consumption for CCA signatories by 2030, and to develop standards, tools, and technologies with CCA supporters to accelerate the adoption of and verify progress toward 100% renewably powered blockchains by the 2025 UNFCCC COP30 conference.

Given that this is the case, and combined with Nigeria's own Paris Agreement commitments, it is clear that any new blockchain application should be carefully designed for net-zero functioning. The number of nodes in a blockchain should be restricted to what is necessary and sufficient for land administration purposes, and this should be designed-into the blockchain adoption pathways. Using existing blockchains (of which there are more than a thousand) will not give control over the number of nodes in operation. It is therefore necessary to consider other options, such as building a new blockchain and using it for all public service provisions in Nigeria.

6.4 Energy Security

Energy poverty is rife in Nigeria. Nigeria is faced with an extreme lack of electrical energy in the midst of abundant natural energy resources to satisfy the expected need.[49] The operation of blockchains will put extra pressure on the grid, and this needs to be taken into consideration. While this White Paper cannot discuss energy security issues directly, and consider Nigeria's renewable energy policy, etc, it is necessary to consider the implications of high energy use for blockchain operation and to consider innovative solutions. Some commentators may consider this issue to be a deal breaker for blockchain adoption in Nigeria. It is noted that long term solutions need to be put in place to address the fundamental issue of energy poverty. However, one innovative solution that can be adopted to keep continuity in the blockchain systems in Nigeria is to have a back-up node in a geographical region outside the country. This raises obvious issues of loss of control, and lack of applicability of Nigerian laws to this back up node.

Both these concerns can be addressed via the concept of the *Data Embassy,* a novel concept in international law. First formed by Estonia, with the Grand Duchy of Luxembourg, the Estonian data embassy in Luxembourg is meant to provide a safe and secure space for Estonia's e-government operations.[50] A vicious attack on Estonian government servers by party or parties unknown brought many of the e-public services in the country to a standstill, and solutions needed to be explored. The data embassy was conceived as a solution to this security breach and is currently in operation.

This research appropriates this cyber security solution as an answer to a developmental need – i.e., insecure power supply in a country operating its public services on blockchain. This option requires further research. Since Estonia signed the Data Embassy Agreement with Luxembourg, the European Patent Office has also entered into a similar agreement with Luxembourg. It would

[48] https://cryptoclimate.org/accord/ accessed 19-07-2023.
[49] Yekeen A. Sanusia, Gideon S. Owoyelea, Energy poverty and its spatial differences in Nigeria: reversing the trend *Energy Procedia* 93 (2016) 53 – 60
[50] *Agreement between the Republic of Estonia and the Grand Duchy of Luxembourg on the hosting of data and information systems* https://www.riigiteataja.ee/aktilisa/2280/3201/8002/Lux_Info_Agreement.pdf accessed 19-10-2023.

be necessary to consider friendly and neutral countries that Nigeria is able to get into an agreement with, for its Data Embassy. As the concept suggests, immunities and privileges embedded in international diplomatic conventions will be applied to this unique form of an embassy, i.e., Data Embassy.

In sum, considering the issues and prospects laid out thus far, this White Paper lays out the following Recommendations.

- Consider the development of a blockchain for Nigeria – 'Nigereum',[51] a new blockchain. This provides control over carbon emissions of the blockchain operation.
- Consider consolidating all government services, including the Hyperledger-based e-Naira to be built on Nigereum.
- Consider negotiating a Data Embassy agreement with a third country. This will enhance cyber security and energy security for Nigereum.
- Implement STDM in parts of Lagos where there is a land tenure data gap. This will help provide fuller data for the blockchain land registry.

[51] The name Nigereum has been used here for the purpose of convenience and not as a nomenclatural stricture.

Just because the lizard nods his head, does not mean he is in agreement.

-West African Proverb

7. Implementing Blockchain for Land Governance in Nigeria

Agreement for implementation of blockchain is a tough challenge. A nod for the technology does not automatically translate into agreement for implementation, which requires the right time, the right people, and the right pathways. The key issues include resourcing, and acceptance of the technology. Education, and a medium to long-term resourcing plan will go a long way in this regard. This section first considers the governance framework of federalism as a systemic issue to navigate through.

7.1 The impact of the 'Federal- State Gap' for technology adoption

The federal government's endorsement of blockchain-based land administration aims to streamline processes, minimize corruption, and enhance investor confidence across the country. However, the implementation of this policy encounters challenges due to the decentralized nature of federalism. Each state has the autonomy to determine its land administration policies, procedures, and systems, which are also affected by differing customary land tenure norms. State governments will have to resource the implementation, as well as incorporate the new policy within the current efforts of digitalisation in land administration. This poses a challenge, as states enjoy a varying capacity of resources and a varying level of familiarity with information technology resources.

Information on land documents such as the certificates of occupancy and titles is hard to obtain. There are many discrepancies in the procedures to register land among states, as well as within states, with local governments' processes at times overlapping with state government's responsibilities. Sharing information on registered titles is only possible between state capitals and the federal territory.[52] These discrepancies and overlapping competencies make the wide application of blockchain challenging.

Another important challenge is the overall mistrust of local actors and traditional rulers towards state and federal governments. In a recent study on the perception for the importance of institutional actors in implementing sustainable land management, local actors such as farmers and village heads were found to perceive the state government less important than the federal government in addressing land degradation.[53] This could pose a challenge to the effective introduction of a new policy as users not only need to be made aware of technological solutions to land management, but also trust in institutions needs to be improved.

Given the above, the adoption of blockchain technology may vary among states, leading to inconsistencies and potential difficulties in seamless operation of the Land Use Act 1978. Ongoing coordination, capacity building, and a commitment to strike a balance between federal laws, emerging technologies, and local land governance practices is needed for the policy to come to fruition in the country at large. The commitment to and to capacity building and coordination between the federal government and states can be seen in the adoption of the iSDG-Nigeria model,

[52] Adeniyi, P (2013) Improving Land Sector Governance in Nigeria: Synthesis Report, The World Bank.
[53] Ademola A. Adenle, Sébastien Boillat, Chinwe Ifejika Speranza (2022) Key dimensions of land users' perceptions of land degradation and sustainable land management in Niger State, Nigeria, Environmental Challenges (Volume 8).

that showed the need for coordination between states and federal government in the pledge to achieve land security[54].

For these reasons a proof of concept that the technology works is needed so that blockchain solutions to land administration can be of interest to the administrative stakeholders at state level. The process of coming to grips with the technology runs alongside the development of better understanding of the specific challenges in diffusion of blockchain technology into land registry processes.

Nigeria's land administration is a shared responsibility between the federal government and state governments. While federal laws provide a framework for land governance, the implementation and enforcement of these laws occur at the state level. This is an important factor in the adoption of blockchain for land administration since the policy is national, but its implementation is across the 36 states of Nigeria. Once this issue is taken in hand, the implementation of the policy could look as follows. This research proposes the following timeline and model of adoption, chosen based on extensive desk-based research and stake holder interviews.

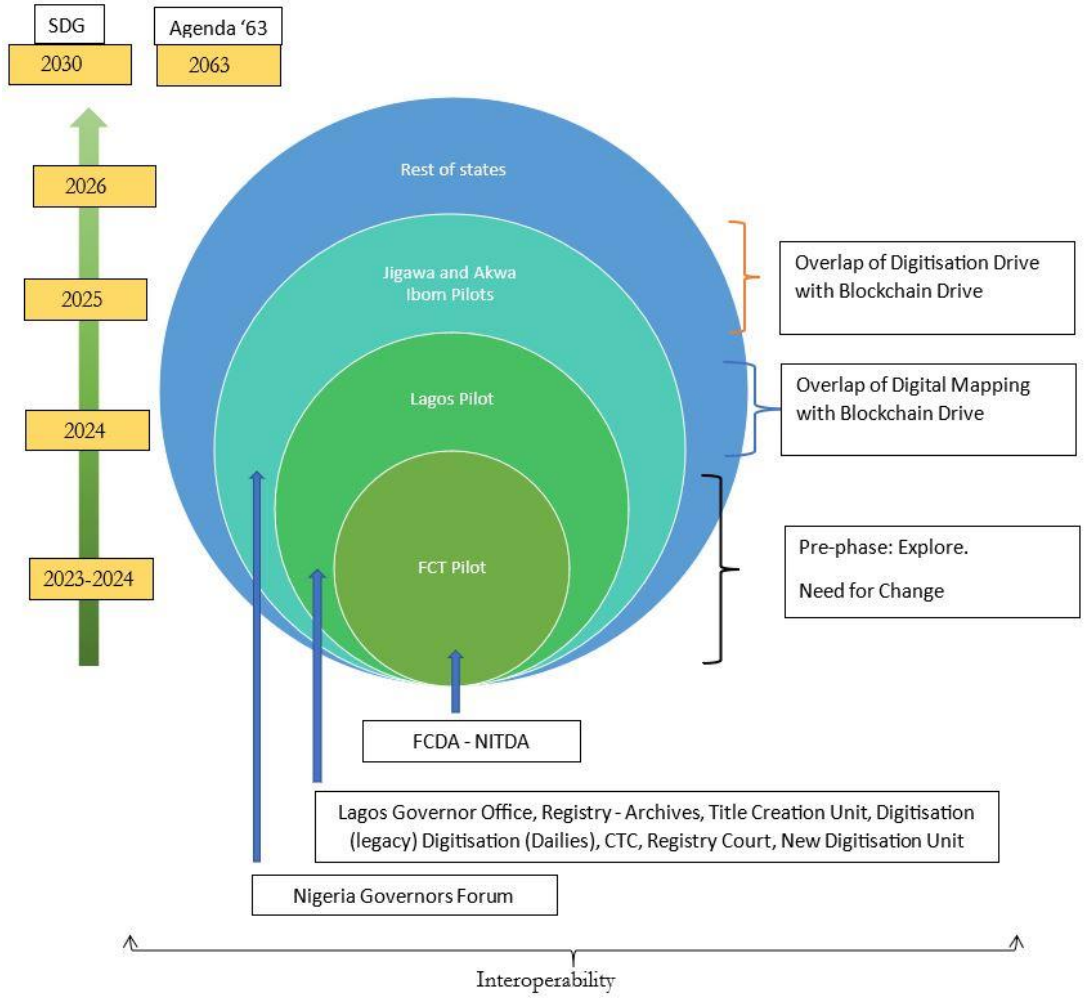

Figure 2 Blockchain adoption for Land Administration in Nigeria

[54] Nigeria's Integrated Sustainable Development Goals (iSDG) model Report (23 Sep, 2019) https://www.undp.org/nigeria/publications/nigerias-integrated-sustainable-development-goals-isdg-model-report accessed 19-10-2023.

7.2 A Minimum Viable Blockchain Product for Land Administration in Nigeria

This research recommends the use of the Minimum Viable Product (MVP) that has been developed by this team for adopting blockchain for land administration in Nigeria. This section discusses the MVP, it's design and the multi-disciplinary expert group discussions that produced the MVP.

To understand the functioning of blockchain technology and to introduce it to a set of test-users based in land administration and conveyancing, the research team tasked itself with creating a smart contract based on basic land transactions, with a sample set of land law rules. A basic user interface has been developed, on which test-users can perform various functions, ranging from registering a title on blockchain, selling and buying land, obtaining governor's consent, and settling title disputes. This website is live, and available for any reader of this report to enlist as a tester. The team encourages anyone interested to contact them.

Appendix 3 of this White Paper provides full detail on the design of this blockchain MVP. It describes the technical requirements necessary to demonstrate the application of blockchain technology in land administration in Nigeria to all stakeholders in this project. This document details the use cases from land administration. The use cases determine the features and functionalities of the MVP. The following transactions can be performed.

- land re-registration (including existing documents digitization) and land re-allocation by the law-office to the current owners on the blockchain.
- land registration and allocation by the law-office to the individuals or entities on the blockchain.
- sales and transfer of land ownership (in the secondary market) on the blockchain.
- handling dispute between parties regarding land ownership.

The commissioning and the execution of this MVP provided valuable insight to the legal research team to experience firsthand the promise (and drawbacks) of blockchain. Several issues arose in the process of discussing the technology and its suitability of its adoption for land administration.

The immutability of records once fixed in a block gave rise to concerns about rectification of details on a land title document. Potential solutions, although as a last resort, would be to 'burn' a record and create a new one, although this was not ideal. The level of transparency that can be achieved through blockchain is quite high, this gave rise to concerns on privacy and data protection. However, we arrived at the conclusion that with a good design, these issues can be satisfactorily addressed and a balance between the various rights of privacy, data protection and transparency can be successfully met. A permissioned and permissionless blockchain were two design options available, of which the team eventually chose a permissionless blockchain after having considered a permissioned blockchain. This is not surprising given the need for members of the public to be able to view land transactions, and they are able to do so only through permissionless blockchains. However, the bar for transparency was set even higher as the teams' analysis of true transparency took it to the conclusion that transparency is only fully achieved when it is achieved across all land administration processes and stake holders simultaneously. The B-CAN-T project's MVP, as a result of the discussions on true transparency, integrates land registry administration processes with land transaction processes all in one blockchain smart contract. This

is a significant aspect of the design that has been developed by the technical team. Estate agents, land conveyancers, the public, and the land registry can all use the blockchain land registry and transactions portal as the one stop shop for a variety of land related activities.

The method of adoption of blockchain for land administration was also considered. A wholesale adoption of a blockchain registry or a stepped approach to adoption of blockchain registry were considered. From a lands' bureau perspective, some key questions to be asked and answered would be, should they adopt

- Only a blockchain based land registry.
- Blockchain based registry plus land market transactions.
- All business processes plus blockchain based registry plus land market transactions.

7.3 Cybersecurity concerns regarding Blockchain.

Amongst the key concerns raised by the legal practitioner-MVP testers was the security of the system. Fears were expressed based on incidents in Nigeria wherein private keys were stolen from top company executives and fraud was committed.[55] This brought the team to research into the specific possibilities for breaches which the law of the land does not provide for. With respect to fraud, the legal mechanism to prosecute is already available.

This section will discuss the solutions for cyber security from the blockchain building and operations perspective, and the extent to which the legal frameworks of Nigeria would apply to these. It also recommends new primary legislation to deal with cybersecurity in relation to blockchain.

The blockchain Ethereum is a case in example to study how changes are affected to the blockchain infrastructure.

Forks are changes implemented in a blockchain protocol, an upgrade to a network which can feature a minor update or a significant change. Forks are initiated by community members as well as developers. Hard forks make previous versions of the chain obsolete. Soft forks are not as radical as hard forks and have backward compatibility. The protocol's development team often uses them to program new features into the codebase.

An Ethereum Improvement Proposal (EIP) is a formal document that describes new functionality or process on the Ethereum blockchain. Given the complexity of a well-written EIP, generally, they are created by application developers. The guidelines for writing an EIP are outlined in EIP1. A fork of the chain can include several EIPs.

The first hard fork of the Ethereum blockchain containing the network's genesis block, Frontier, was deployed in July 2015. The first block contained 8,893 transactions of all the users participating in the crowd sale. Over 72 million Ether were pre-mined for the launch, 12 million of which went into the development fund.

[55] Dachen Issac (16 July 2023) *Interpol arrests Nigerian fraudster for allegedly stealing $87m from blockchain firm* https://www.ripplesnigeria.com/interpol-arrests-nigerian-fraudster-for-allegedly-stealing-87m-from-blockchain-firm/ accessed 31-07-2023.

Subsequent hard forks have been carried out. The Homestead upgrade in 2016 enhanced smart contract functionality on Ethereum. In 2017, Ethereum entered a long running phase to become a proof of stake (PoS) protocol. The Byzantium and the Constantinople hard forks set the stage for the transition to proof of stake. The Constantinople hard fork was deployed in two stages – through EIP1234 by changing the rewards for miners (after the hard fork, they could get 2 ETH instead of 3 per mined block), the second phase was implemented to optimise gas costs.

A new blockchain called Beacon Chain was created to check that the PoS consensus logic was reliable enough to be used on the Ethereum Mainnet. It ran in conjunction with the Mainnet, and later took over from the Maninet in an event known as The Merge where the old consensus mechanism, mining and block propagation was handed over to Beacon Chain. The function of Beacon was to receive transactions from the original chain, bundled them into blocks, and grouped them into a blockchain that worked on PoS. Beacon Chain introduced staking, where network participants could now stake their Ether and validate transactions and get rewards.

The highly anticipated upgrade to a more sustainable and eco-friendly consensus mechanism was deployed on 15 Sep, 2022. The transition was expected to lower Ethereum's energy consumption by 99.5%, reduce transaction confirmation times, and make the network more decentralised due to lowered costs of becoming a node operator.

While these were planned hard forks, Ethereum also underwent an unplanned hard fork, arising from a serious incident. This raises cyber security concerns and points to the need for regulatory interventions. In 2016, an event known as the DOA incident occurred. DOA – Decentralised Autonomous Organisation was deployed on Ethereum blockchain in 2016, as a decentralised business model for the organisation of both commercial and non-governmental enterprises. It did not have a conventional management structure or a board of directors. During its funding period it raised $150 million worth of Ether from more than 11,000 people, making it the most successful crowdfunding in history. In June 2016, a reentrancy bug led to a theft of 3.6 million Ether. The hackers attacked the smart contract and created a 'child DOA' to which funds were transferred. Since this was a copy of the original smart contract, the funds were frozen for 28 days, as it would have been in the parent DOA as well. Within the 28 days, the bug was discovered, and a new EIP was drafted. The controversial EIP-779 was put forward to implement a change in the lockup contract. The majority of the mining power agreed with the proposal and voted to do a hard fork. Those who wanted to stay on the old chain shifted to Ethereum Classic protocol.

This account of the changes implemented on Ethereum demonstrates the core workings of the blockchain over the course of its lifetime. Changes are made, and implemented very much like a policy process works in democratic governance. The major changes reflect the values of the majority of the miners and responds to external factors. The DOA incident demonstrated how controversial an EIP could be, very much akin to processes in governance where controversial policy proposals are put forward by ministers. The event on the blockchain called The Merge shows the value embedded in the EIP that affected this change on the blockchain. The Merge is meant to deliver a more ecofriendly and sustainable blockchain. This reflects the aims of the CCA – Crypto Climate Accord, a concerted effort by the crypto and blockchain industry to reduce the greenhouse gas emissions of their operations.

The cybersecurity concerns raised by legal practitioners and Lagos Lands Bureau personnel, which are illustrated through the Ethereum blockchain history, can be responded to effectively if the state itself commissions the creation of a new blockchain and subsequently oversees all the blockchain improvement proposals. The improvement proposals will proceed like any other policy proposal and can be closely aligned to the processes of rule of law, both substantively and procedurally. Technical experts in conjunction with policymakers should determine the Blockchain Improvement Proposals. Blockchain should be considered as national infrastructure, and a certain level of oversight and monitoring should be placed over the developers of the blockchain who affect hard and soft forks.

7.4 Decentralisation and its challenges

Blockchain is built on 'trust less' trust technology, i.e., allowing machines to execute functions without human interference, and which therefore does not require trust in human-mediated processes which are susceptible to undue influence. The full benefit of this technology is set to derive from a type of blockchain known as permissionless blockchain, which is supported by many blockchain participants (unknown to each other) acting without a central authority, i.e., decentralised functioning. While this may be suitable for applications such as payments, product tracking, and other such private transactions, the technology comes as a 'disruptor' for public ledgers issued by and maintained by public authorities, such as the Land Register. An alternative for permissionless blockchain is the permissioned blockchain, which relies less on decentralisation, but is criticised for its lack of transparency and concentration of decision-making power. Decentralisation is said to hold immense opportunities not just for technology growth, and faster market transactions, but is considered as a new way of governance. Herein lies the challenges. Even if we were to accept that decentralisation is inevitable as 'GovTech' is supposed to reach $1 trillion by 2025,[56] how do we govern the transition from centralised governance to decentralisation? And what are the risks involved in this? How are the interests of those who are outside the blockchain ecosystem protected? How are the voices of those who are outside the decentralised system of blockchain heard, w.r.t to the governance issues involved? One part of this dilemma has been addressed in the earlier sections, in terms of bringing accountability and responsibility to core developers through a larger consensus mechanism involving non-blockchain and off chain participations in the blockchain improvement proposals. Traditionally governments took care of public interests (or failed in their duty to do so), but in the world of decentralised tech, who takes care of public interest?

A brief account of Georgia adopting blockchain land administration provides an insight into the choices made and instructive on the above-mentioned issues. Georgia's land administration had been characterized by weak governance. Records in many cases were spotty, due in part to the chaos that accompanied the collapse of the Soviet Union in 1991, as well as the high level of corruption that plagued Georgia during the early years of independence.[57] In the mid-2000s, Georgia began digitisation of land records as a measure of reform, and in 2016 commissioned

[56] Nick Ismail (12 November 2018) *GovTech to hit $1 trillion by 2025* https://www.information-age.com/govtech-1-trillion-2025-11990/

[57] Inge Snip (19 April 2017) *Georgia: Authorities Use Blockchain Technology for Developing Land Registry* https://eurasianet.org/georgia-authorities-use-blockchain-technology-for-developing-land-registry

BitFury, a blockchain company to develop a system of registration of land records on blockchain.[58] By 2017, about 100,000 land titles have been registered under the program. The National Agency of Public Registry (NAPR), an office of the Georgian Ministry of Justice operated this blockchain built by Bitfury. It was designed as a permissioned blockchain, tied to the bitcoin blockchain suggesting a form of merge-mining to secure the land registry. Papuna Ugrekhelidze, then chairman of the NAPR, stated the benefits expected from the system:

> "By building a Blockchain-based property registry and taking full advantage of the security provided by the Blockchain technology, the Republic of Georgia can show the world that we are a modern, transparent and corruption-free country that can lead the world in changing the way land titling is done and pave the way to additional prosperity for all."[59]

By 2018, a total of 1.5 million land titles in the Republic of Georgia were published on the Blockchain.[60]

Georgia's blockchain registry is not fully decentralised, and it is also susceptible to risk. According to a sector analyst, "Future risks might include platforms which lose developer interest or support, flaws in the blockchain's code or smart contracts, the cracking of the encryption algorithms by quantum computers, a fork in the developer ecosystem or state intervention,".[61] State intervention almost certainly will be foreign state intervention, which is a key risk in blockchain when incorporated as part of a state's infrastructure.

In view of the above analysis, the following recommendations are put forth.

- Consider the development of a blockchain for Nigeria – 'Nigereum',[62] a new blockchain. This provides enhanced cybersecurity and safeguards sovereignty.
- Draw up NIP 1 (Nigereum Improvement Proposal 1) including NITDA as a decision maker on NIPs.
- Decide on the development fund for Nigereum – potentially in e-Naira.
- NITDA to use its law-making consultative powers to propose new rules governing core developers of Nigereum to be subject to Nigerian laws and policies. The next iteration of the NITDA Blockchain policy is to stratify capacity building, with a strategic focus on developing core developer capacity and hardware capacity in Nigeria, beyond the aspiration of creating many low-, and middle-income jobs populating the blockchain ecosystem.
- Consider negotiating a Data Embassy agreement with a third country. This will enhance cyber security for Nigereum.

[58] Qiuyun Shang, Allison Price (2018) A Blockchain based land titling project in the Republic of Georgia rebuilding public trust and lessons for future pilot projects, *Innovations,* 12: 3/4 https://direct.mit.edu/itgg/article-pdf/12/3-4/72/705280/inov_a_00276.pdf

[59] *Supra fn.58*

[60] *Supra fn.59*

[61] *Supra fn.58*

[62] The name Nigereum has been used here for the purpose of convenience and not as a nomenclatural stricture.

8. Proposed Pilot projects in Blockchain Land Administration

8.1 Abuja

A blockchain pilot in Abuja is a natural step for the implementation of a national policy. Stakeholder interviews with NITDA reveal that a pilot project is being contemplated for the Federal Capital Territory.

This section considers the legal frameworks relevant for the accurate writing of the smart contract that will operate for the land administration blockchain pilot in the Federal Capital Territory.

Decree No.6 of February 5, 1976 led to the establishment of The Federal Capital Development Authority (FCDA), bestowing the ownership and control of all land in Abuja to the Federal Government.[63] The Ministry of the Federal Capital Territory (MFCT) and the FCDA deal with land administration in the territory under its purview. The relevant legal framework in FCT fall into four categories of laws, regulating the control, management, acquisition and devolution of land rights, namely:

1. The received land law comprising of the English common law, equity and statutes of general application in force in England on the 1 January 1900 and made applicable by the Law (Miscellaneous Provisions) Act.[64]
2. The FCT Act as amended.[65]
3. The Land Use Act applicable subject to section 49(1) and as adapted by section 51 of the Act, and to the extent permitted by section 297(1) of the Constitution of the Federal Republic of Nigeria 1999, and section 1(3) of the FCT Act as amended.[66]
4. The Laws set out in the second schedule to the FCT Act affecting the acquisition, perfection, devolution or extinction of land rights, e.g. Law Reform (Contracts) Act;[67] Illiterates Protection Act;[68] State Lands Act;[69] Buildings Lines Regulation Act;[70] Stamp Duties Act;[71] Land Registration Law;[72] Registration of Titles Act;[73] Recovery of Premises Act;[74] Administration (Real Estate) Act;[75] Survey Law;[76] (Nigerian Urban and Regional Planning Act,[77] and Regulations made thereunder[78]); Limitation Act.[79] These Laws shall apply with the necessary modifications,[80] and adaptations.[81]

[63] Smith I.O (1999) Practical Approach to Law of Real Property in Nigeria, Lagos, Ecowatch Publication Nig.Ltd.
[64] Cap 86 Laws of Nigeria 1958.
[65] Cap F6 LFN 2004.
[66] Cap L5 LFN 2004.
[67] Cap 64 Laws of Nigeria, 1961.
[68] Cap 83 Laws of Nigeria, 1958.
[69] Cap 45 Laws of Nigeria, 1958.
[70] Cap 28 Laws of Nigeria 1958.
[71] Cap 411 Laws of the Federation of Nigeria, 1990.
[72] Cap 97 Laws of Northern Nigeria, 1958.
[73] Cap 181 Laws of Nigeria, 1958.
[74] Cap 176 Laws of Nigeria, 1958.
[75] Cap 2 Laws of Nigeria, 1958.
[76] Cap 129 Laws of Northern Nigeria, 1958.
[77] No 88 1992
[78] FCDA Development Control Regulations April 1996.
[79] No 88 Laws of Nigeria, 1966.
[80] Cap F6 LFN 2004; s.13(3)
[81] S. 13(2).

In Abuja, the practical administration of the law is self-contained and devoid of customary law. The digitisation of records in Abuja is a convenient phenomenon that enables the consideration of Abuja for the first pilot of a blockchain based land registry.

The presence of the AGIS – Abuja Geographic Information system, in conjunction with the Land Information Systems (LIS) supports the choice of Abuja as a site of the first blockchain-based land registry pilot. The GIS is the graphic aspect, where all cadastral information such as the master plan, land use plans, detailed site development plans, engineering infrastructure and all survey information are stored in digital form. The LIS constitutes the land attributes such as records of allocation (name of allottees, plot numbers, plot sizes, uses and locations). It also includes records of all transaction such as power of attorney, deed of assignment, mortgages, subleases, releases, devolution, etc. It achieves a comprehensive, and state-of the-art computerized geospatial data infrastructure for the Federal Capital Territory Abuja. The data available in Abuja promises to be rich, complete, stable, reliable and accurate, creating favourable conditions for a pilot project.

Supplementing this is an assessment of the governance bottlenecks conducted in October 2010 on the AGIS and LIS, funded by the United Nations Development Programme (UNDP), the Independent Corrupt Practices and other Related Offences Commission (ICPC) through the organisation Self-Help Development Facilitators (SEDFA) on the land administration in the FCTA. Other institutions covered by the study complete the ecosystem of the land governance in Abuja, and they include Survey and Mapping Department Urban and Regional Planning Department (URPD), Land Administration Department, Department of Development Control, Department of Resettlement and Compensation, Department of Mass Housing. Some of the findings in the study are relevant to the implementation of blockchain, and with careful and considered strategy for blockchain implementation, these issues can be addressed and pathways for resolution found. The governance bottlenecks identified were -

1. Lack of policy documents and standardized procedures regarding land administration processes.
2. Lack of institutionalized independent audits of land records/inventory in the FCT.
3. Lack of access to information by the public e.g. to inspect the records and inventory of land in the FCT to be able to monitor illegal land transactions.
4. Lack of speedy resolution of disputes, conflicts and corruption cases relating to land administration.
5. Lack of an effective complaint system for clients of land administration.
6. No defined time span for processing an application – from submission to outcome.
7. The inconclusive state of the Regularization of land titles previously issued by Area Councils of the FCT by AGIS/Land Administration Department.
8. Inadequate public participation in the planning and implementation of land policies in the FCT.
9. Overlapping responsibilities of AGIS, URPD and the Survey and Mapping Department

The following were identified as corruption red flags:

1. Forgeries and cloning of land documents.
2. Allocation of plots of land made without the FCT Minister's approval.

3. Presence (beyond regulated time of 2 years) of pockets of undeveloped plots of land in districts with engineering infrastructure
4. Missing of land documents in AGIS and Land Administration Department
5. Existence of Land Syndicates and Speculators
6. Revocation of certain Land Titles without due process
7. Fake layouts and Fraudulent Allocations in Area Councils
8. Differences in land use in the records of AGIS and Urban and Regional Planning Department
9. File scams in AGIS/ Land Administration Department
10. Delays in processing land documents
11. AGIS payment scam

The discussion would be how blockchain would help resolve these problems and whether it is an efficient and practical mechanism to do so. Four design options exist that can progress the discussion to find the right fit for the problems that exist in the system. The options are:

1. Permissioned Blockchain Land Registry
2. Permissionless Blockchain Land Registry
3. Digitisation of Land Records
4. Permissioned or Permissionless Blockchain of Land Records alone

In testing a minimum viable product for land administration, this research experimented with a Permissionless blockchain, after having initially considered a permissioned blockchain. As alluded to in the discussions of the MVP, several considerations regarding security of data and privacy were pitched against the need for transparency in the system. This is a discussion that needs to take place in real time alongwith the concerned departments that hold and transact in this data.

Therefore, to sum up the above analysis, and to suggest actions going forward, this White Paper lays out the following Recommendation.

- Consider a pilot project built on an existing blockchain, e.g., Ethereum, for a blockchain-based land registry in the Federal Capital Territory of Abuja.
- Use MVP built as a
    - Permissionless blockchain
    - Incorporates gatekeeper roles reflecting extant property law.

Figure 3 The legal research team at Lagos Lands Bureau's new Digitisation Premises, Ikeja, Lagos. June 2023

8.2 Lagos

The legal research team spent a week in Lagos involved in semi-structured interviews covering a range of issues related to blockchain implementation for the land administration in Lagos. The team visited the Lagos Lands Bureau offices in Ikeja and also saw firsthand the operation of the offices. The following section will lay out some of the findings and further steps for blockchain adoption in Lagos's land registry.

A pilot project in Lagos is essential to take account of the singular and unique features of Lagos State. Although a pilot project in Abuja will provide several pointers for designing the scaled-up version, the Federal Capital Territory's land administration differs from that of states, and therefore it cannot be replicated fully. This necessitates a bespoke pilot in the states, and Lagos is a good state to begin.

For the Lagos Lands Bureau staff to meaningfully engage with the design of a pilot, it is essential that they become familiar with the notion of blockchain and its operation using the MVP designed as part of this project. The current knowledge amongst staff ranges from vague acquaintance with blockchain to reasonable knowledge of cryptocurrency. This section of the WP focusses on the strategies for light touch, yet pervasive efforts to introduce blockchain to Lagos Lands Bureau, and they are as follows:

> **High Level Consultation** – The team at the Lagos Lands Bureau is open minded and willing to engage in adoption of new technologies. The technology needs to be adopted in the context of ongoing work in the Bureau on various initiatives to enhance their

operations and service delivery. High level consultation on aspects of blockchain technology adoption are required, and need to be planned, ideally in the early part of 2024 to identify a suitable team to steer blockchain in Lagos state Lands Bureau. The Land Registry is likely to be the key player within the Bureau. The team should include individuals with remit of industry-facing liaison, FCT pilot liaison, internal facilitator, among other roles needed to implement this new process change.

Sensitisation drive – The sensitisation drive should be externally designed, and delivered internally, through internal mechanisms. The external designing takes away the onus from the Lands Bureau to develop accurate information for awareness and training purposes. Recruiting champions within sections of the Lands Bureau is essential. Blockchain champions are those who are enthusiastic and willing to share their enthusiasm with others in their section through learning about and reflecting on blockchain as a game changer in their day-to-day work at the Bureau. Creating interest and a conducive environment for critically assessing this technology for the functions of the Lands Bureau is the main purpose of this Sensitisation Drive.

Training Sessions - Training and awareness of the technology among the digitisation team, the CTC team, the archive team, the dailies team, are essential. Different from and separate to the sensitisation drive is a direct taught programme, carefully tailored for being accessible, with technical jargon broken down accessibly.

Visibility and Commitment – Visibility of blockchain on notice boards, in team meetings, and in ad hoc meetings will be a good way to introduce the institution to the concept of blockchain. Other use cases, successful examples in land administration in other jurisdictions, challenges in other jurisdictions can be the subject of the posters and bite-sized information in visible spaces in the Lands Bureau. This should be backed up by commitment from team leaders, and the senior management. The high-level consultation mentioned above will help in this regard.

Opportunities and progression – Staff should feel incentivised to take on change. Block-chaining land records comes with risks, and the frontline officials bear the brunt of this. Therefore, the institutional staff development and human resource development mechanisms such as promotions etc should be updated with incentives built in for transitioning to e-governance. Change should be valued by the organisation, including changemakers.

Special Factors – Staff at the Lands Bureau should be encouraged to view technology as part of their role in fulfilment of SDGs and Agenda 2063. Cross-departmental engagement with units in other Ministries and agencies should be actively encouraged and facilitated. NOTAP (National Office for Technology Adoption and Promotion) should be engaged to regulate ownership of technology and – open source, proprietary models should be explored and the suitability of the one or the other or hybrid needs to be decided by a broad range of stake holders. Including NOTAP as one of the stake holders brings a breadth of knowledge and experience on low-cost technology acquisition or technology transfer aspects of blockchain.

Partnership working - Going forward, it is important to forge partnerships with organisations that have an interest in blockchain, as well as with organisations that can be independent arbiters of this technology, assessing it at arm's length, but feeding back this assessment into the process of implementing the national policy on blockchain. Potential partners include SiBAN (Stakeholders in Blockchain Technology in Nigeria), Nigeria Computer Society (Interest Groups in Nigerian Technology Professionals in Civil Service NITPCS and Nigerian Women in Information Technology NiWIIT) and international government departments in Singapore, Estonia, Georgia, Switzerland and the US, and with the research team that produced this White Paper.

Disaggregating Tenure-secure and Tenure-insecure Land regions in Lagos– Lagos's land ownership consists of secure and insecure tenures. Large commercial and domestic estates quite possibly are likely to fall within the former category, while smaller scale domestic and commercial properties are likely to fall within the latter category. For purposes of implementation of blockchain for land governance, to start bringing benefit to the land economy through blockchain, the Lands Bureau should disaggregate land in Lagos based on tenure security. The tenure secure lands are also likely to be found clustered in specific areas of the city, and therefore will be amenable to be grouped together through geography. Cascading blockchain from tenure secure areas downwards will allow the scheme to gather money and time, through the Blockchain ABS charge mentioned in the earlier section, and the rollout of the STDM scheme, which will convert tenure insecure land parcels into tenure secure parcels. Eventually tenure security in Lagos will improve and provide quality data for the blockchain systems to handle.

In sum, following on from the analysis in this section, this White Paper recommends the following.

- Consider a pilot project built on an existing blockchain, e.g., Ethereum, for a blockchain-based land registry in the state of Lagos.
- Use MVP built as a
    - Permissionless blockchain
    - Incorporates gatekeeper roles reflecting extant property law.

9. Conclusion

Implementing the policy requires a stepped approach, cascading down into various states, in many phases. The state and central government should work closely with NITDA operationalising the National Blockchain Policy of 2023.

Potential showstoppers for blockchain need to be effectively addressed. NITDA needs to proceed to produce the Blockchain strategy at the earliest possible opportunity, and its steering committee should consider a wider a range of issues, including radical thinking around the creation of blockchain infrastructure for Nigeria. The use of existing blockchains will threaten state sovereignty and increase carbon emissions. The regulatory landscape for blockchain should be bolstered through new primary and secondary legislation. Adoption of the Social Tenure Domain Model will supply quality data and secure a social license to operate for this technology. Pilot projects in land administration systems in Lagos and Abuja will help operationalise the National Blockchain Policy of 2023.

Appendix 1: Technology Assessment (TA) in the Context of the Application of Technology for Land Administration in Nigeria

By Olusola Babatunde Adegbite

BACKGROUND

Technology Assessment (TA) is the practical process of studying and evaluating a new technology, to determine its suitability for a specific purpose. It is a form of policy research that examines short-term and long-term consequences e.g., economic, social, environmental, etc. of technology application.[82] Explaining it more broadly, the United Nations Conference on Trade and Development (UNCTAD) states that:

> *Technology Assessment (TA) is a problem-oriented process that examines the societal effects when a technology is introduced, extended, or modified. TA is an interactive, communicative, and scientific process which aims to contribute to the formation of public and political opinion on the social aspect of science and technology, risks and opportunities, providing effective, pragmatic, and sustainable options for policy actions.*[83]

According to Hennen, et al, TA is an interdisciplinary activity that responds to the emergence of new scientific and technological developments, artefacts, processes, services, societal problems, and concrete policies, with a view to determining its effect on different aspects of societal life.[84] When a well-structured TA process is successfully completed leading to the selection of a proposed technology, not only will it bring immense benefits to the end users, but it can also create a competitive advantage for the country with its peers across the globe. The origins of institutionalized TA can be found in the Office for Technology Assessment in the United States of America in 1970s,[85] and since that time, TA has become well-developed in most advanced nations, except that in much of sub-Saharan Africa, it is still in an infant stage.[86] In countries such as Nigeria, TA may still be said to be at a very rudimentary phase.

However. there is a growing momentum towards TA systems and it is increasingly being recognized as a useful policy tool in Africa. Much of this is driven in part by the UNCTAD methodology on the TA process and its seven steps approach.[87] These steps include the following - Governance and Steering; Priority Setting; framing project questions; Setting Project Goals; Project Implementation; Quality Control; Reporting.[88] This methodology may be useful in understanding how developing a TA process on technology in land administration in Nigeria can

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[82] *See*, David Banta, 'What is Technology Assessment? (2009) 25 (1) *International Journal of Technology Assessment in Healthcare*, 7 – 9 at 7.

[83] *See*, 'Technology Assessment in the Energy and Agricultural Sectors in Africa to Accelerate Progress on Science, Technology, and Innovation' *UNCTAD*, https://unctad.org/project/technology-assessment-energy-and-agricultural-sectors-africa-accelerate-progress-science accessed 14/07/2023.

[84] L. Hennen, et al, 'Introduction: Technology Assessment Beyond National Boundaries' in L. Hennen, et al, (eds.) *Technology Assessment in a Globalised World: Facing the Challenges of Transnational Technology Governance*, (Springer, 2023), 1 – 271 at 2.

[85] L. Hennen, et al, *ibid* at 3.

[86] *See*, UNCTAD Technology Assessment Project, Concept Note For Training Workshop on TA Project Steering Committee and Expert Group, 4th March 2022, 1- 2 at 1, https://unctad.org/system/files/information-document/Concept_UNCTAD_TA_Seminar_4_Aug_22.pdf

[87] *See*, Technology Assessment in Developing Countries: A Proposed Methodology, United Nations Conference on Trade and Development (UNCTAD), Geneva 2022, file:///C:/Users/oluso/Downloads/tcsdtlinf2022d4_en.pdf

[88] *See*, UNCTAD Technology Assessment Project, *supra* at 1.

be successfully executed. It is important to examine how each of these steps can be particularized with respect to land administration in Nigeria.

I. Governance and Steering Process:

This is the first step in the TA process. For a successful TA process, a sound and inclusive governance structure to drive the TA process is imperative.[89] The provision of a governance and steering process reflects the intentions of Article 4 (1) (2) of the Draft Convention on the Right to Development (DCRD).[90] This means that with respect to the implementation of blockchain technology in land administration in Nigeria, the first and major step is to set up a most important body in the TA process i.e., a Steering Committee (SC). Amongst other things, the SC will lead the process, its governance, and the administrative issues, and ensure a smooth and timely process of how technology can be applied to transform land administration in the country. Upon being set up, the SC will also have the responsibility of choosing the rights experts to aid the success of the TA process. It would be expected to constitute an independent Expert Group (EG), made up of individuals with requisite technical knowledge in this area. Such EG expectedly would be made up of experts from relevant technology fields as well as leading scholars in land and property law, legal practitioners, regulators, etc. who would be responsible for implementing the TA process as well as developing a TA report. This approach helps to harvest dispersed knowledge across-board, develop socially inclusive solutions, and deepen the democratic process.[91] The organizational capacity of these two groups must be strengthened and their capacity for successful networking must be enhanced.

II. Priority setting:

Following the establishment of a governance and steering process, there would be a need for priority setting. Priority setting is key as TA takes considerable human and material resources and for developing or least developed countries with very limited, it is really important that a sort of scale of preference is determined on the technology to focus on. The SC plays a central role in making decisions on priority technology, with assistance from other stakeholders, firms, and entrepreneurs. This is in tandem with Article (8) (4) of the DCRD which states that states have a right to formulate, adopt, and implement appropriate national development laws and policies in line with the right to development towards its realization.[92] It is expected that these decisions should examine demand-side considerations i.e., the fact that the technology in question is functional and suitable for solving economic, social, and environmental development challenges in the country. It could also be based on supply-side considerations i.e., that the technology is just emerging in other parts of the world and would therefore be useful to address local sustainable economic and social development. It is important that priority setting is driven by the development need of the country, which for instance may be distilled from the country's national development plan. In developing countries with certain limitations in advanced technologies expertise, the UNCTAD advises that a broad spectrum in which early innovations have possible technology applications would be a more appropriate approach for a TA project. In the context of developing countries such as Nigeria, development needs revolve largely around issues of education, health,

[89] *Ibid*
[90] Article 4 (1) (2), DRCD, Revised Draft Convention on Right to Development, Human Rights Council, A/HRC/WG. 2/23/2 (6 April 2022).
[91] *See*, UNCTAD Technology Assessment Project, *supra* at 1.
[92] Article (8) (4), DCRD.

employment, housing, etc. It, therefore, means that an SC must give priority to innovations, offering opportunities for a broad spectrum of technologies that can address these needs.

With this in mind, it means that in the case of land administration in Nigeria for example, which interconnects housing as a development need, the SC would have to determine whether blockchain technology is the right technological fit to deliver quick solutions on issues such as transfer of land, allocation of land, land registration, etc. in the country. Answering this question is really important as a wrong technology might end up being counterproductive. Importantly, the SC must understand that priority setting can't be private or internal to the institution sponsoring the project i.e., whether it's a government agency or a private sector sponsor, rather it must be accountable to the general public.[93] In other words, the TA project must include a process that is open, fair, and credible to discriminate amongst the range of technologies it may be assessing.[94]

III. Framing Project Questions:

This third step requires that the prioritized technology be situated in a national context. This involves analyzing the societal, political, and scientific domains connected to the prioritized technology in order to define an exact problem to be targeted by the TA process. In the course of this step, relevant background knowledge is gathered and analyzed to identify an exact problem to be studied and to choose the most effective project design for this purpose. The EG leads this step with the support of the SC and a project manager. To do this, actors and stakeholders mapping is key as it would lead to in-depth knowledge about individuals and organizations that would be involved in the latter phase of the project. In this instance, actors directly involved in developing, regulating, and governing the technology for land administration e.g., universities, research institutions, international agencies, etc., as well as stakeholders in the land administration sector who are to be impacted by the implementation of this technology must be mapped. Framing project questions is an approach encouraged by the Draft Convention on Right to Development (DCRD) which provides in Article 4 that:

> *Every human person and all peoples have the inalienable right to development, by virtue of which they are entitled to participate in, contribute to and enjoy civil, cultural, economic, political, and social development that is indivisible from and interdependent and interrelated with all other human rights and fundamental freedoms. Every human person and all peoples have the right to active, free, and meaningful participation in development and in the fair distribution of benefits arising therefrom.*[95]

The key point here is that actors and stakeholders have explicit and implicit knowledge about the issues at stake i.e., critical development needs of the country, and that is why mapping is important to distill this knowledge. In the course of this step, discourses and debates on the proposed technology must be aggregated and analyzed. So, for example, in framing questions for the possible use of blockchain technology in land administration in Nigeria, there would be a need to determine the thoughts of critical stakeholders such as business groups, entrepreneurs, trade unions, farmers, traders, market women, commercial transporters, traditional family institutions, property developers, civil society organizations, etc. on the technology in the context of what they consider the immediate development needs of the country. Knowledge from such people on whether the application of this technology can meet development needs such as access to affordable land, and

[93] *See*, *Setting Priorities for Clinical Guidance (Committee on Methods for Setting Priorities for Guidelines Development)*, in Marilyn J. Field (ed.) (National Academy Press, 1995), 1 – 162 at 79.
[94] *Ibid*
[95] Article 4 (1) (2), DCRD.

in extension, address the housing deficit would be useful in the TA process. Such information can be collected through questionnaires, interviews, etc. to sample public opinion, which can then be aggregated and analyzed.

IV. Setting Project Goals:

As a fourth step, there would be a need to set goals for the project. In this wise, three important goals are in view. The first is about raising knowledge i.e., identifying knowledge about gaps in the technology, the potentials, and the risks. Such gaps may relate to scientific and technological, or social or policy dimensions of the proposed technology. The second is about forming attitudes i.e., creating public debates about the new technology. As a form of agenda-setting, this triggers thematically concrete policies or public debates on new scientific perspectives. This second leg considers the TA process as one that goes beyond mere scientific assessment to fill knowledge gaps, but one designed to transform attitudes and opinions. The third is about initializing actions i.e., influencing the outcome of policymaking processes. It leads to new or adapted STI or sector policies and strategies that give direction for the proposed technology. The need to set project goals is also reflected in the provision of Article 4 of DCRD already stated above.

The SC, as the main organ of the project, can receive advice from the EG on the relative strength of each of these goals. So, in implementing a new technology in land administration in Nigeria important project goals may be to determine the current gap in knowledge with respect to land matters e.g., in the area of customary land tiles. It must then be able to shape the public's attitude around how the proposed technology may solve this problem and the exact point to start initializing action. This will involve the intricate process of bringing the majority of the public to sufficiently see the inherent benefit the new technology portends for them, as against the prevailing status quo ante.

In most developing countries such as Nigeria, there is often little public deliberation of most things. Governments at different levels develop and introduce policies without public debates or input from the people. With such a culture prevailing, achieving the goal of setting project goals on a TA project, through forming attitudes may be a challenge. However, it is a non-negotiable step if the TA process is to succeed. For example, in addition to framing project questions, raising knowledge and forming attitudes can help get a clearer picture of the exact development needs of the country and whether the technology in question is well posed to address that need. For instance, given the diversity of stakeholders concerned with land administration in Nigeria, where it is properly done, setting project goals is the right approach to mining the mind of these groups of people on how best to help them overcome challenges related to land acquisition, registration, etc.

V. Project Implementation:

In an actual sense, project implementation involves examining empirical evidence of good practices that emanated from the successful introduction and implementation of a technology. For developing countries, such examination may be impossible as TA is yet to be implemented in most of these countries. Nonetheless, in the context of such countries, project implementation may still be engaged through the lens of their learning processes. And so, even though there have not been actual technology applications, project implementation can be carried out based on how evidence on the proposed technology is to be collected and analyzed. When this is connected to land administration in a developing country such as Nigeria, it means that gathering, analyzing, and synthesizing evidence about the proposed use of blockchain technology, its core features, risks,

and opportunities, in addressing sustainable economic and social development in the local context is important. This is important as the DCRD provides in Article 13 that states are obligated to cooperate to create a social and international order conducive to the realization of the right to development through building the capacity of developing countries to increase the availability of high-quality, timely, and reliable data.[96]

The first part is gathering and synthesizing evidence on existing literature and data and harnessing additional analytical tools in the local context. This involves the review of core scientific and technical literature from different fields as well as innovation system research and sociology of knowledge. For example, this may involve examining whether blockchain technology has been deployed in other areas of societal life and what has been the outcome in terms of the risk and opportunities assessment. There would however be a need to embed such knowledge into the social, economic, political, and environmental development needs of Nigeria, where this technology is to be implemented. The second part relates to stakeholder involvement based on interactive methods to ensure broad participation. Aside from the knowledge from the EG, in order to significantly improve the quality of outcomes of the TA process, as well as anchor the outcomes in social and political discourses, there is a need to engage in interaction with stakeholder groups, potentially affected societal groups, and the public at large. This way, the SC can sufficiently harvest opinions from a broad spectrum of society on whether or not the implementation of this technology will be successful.

VII. Quality Control:

This step has to do with the need to ensure that the TA process achieves results of very high quality. Feedback loops have to be built into the process to ensure that the quality desired is achieved. On the steps already discussed above, it is important to take reflect at different points on whether the goals that the TA process set out to achieve are the exact outcomes. Essentially, quality control is important in two critical areas i.e., scientific and process quality. With respect to scientific quality control, it is important that the right evidence is what is collected, analyzed, and synthesized so that the right result can be obtained, hence great policy making. On this point, it means that the information collected must be original, organic, and speak directly to the development needs of the people. Since not all information is collected through the formal process, care must be taken that information coming from lay people in local environments and social systems are properly vetted, to ensure that it reflects the people's views. In this instance, control measures such as the use of a peer review process can be deployed, to avoid the risks of a subjective or biased interpretation of evidence.

Regarding process quality, it means the TA process must ensure the achievement of its main goals from every stakeholder's perspective. In this regard, stakeholders must be drawn from a broad spectrum of the country, covering both the public and private sectors. Stakeholders must also include the ordinary people themselves. This can happen by involving groups that directly represent the people such as trade unions, market women, transport unions, religious organisations, etc. As quality here means aggregating the original viewpoint of the people, these groups best represent the means of accessing these views. Article 4 (1) of the DCRD validates this point by stating that in the light of their right to development, every human person and all peoples have a right to participate in and contribute to civil/political and social/economic development.[97] It further adds that not only do the people have a right to participate in

[96] Article 13 (4) (e), DCRD.
[97] Article 4 (1), DCRD.

development, but equally in a fair distribution of the benefits.[98] The benefit of including the people as stakeholders lies in the fact that it helps bring the benefit of the technology being proposed to them, to the end so that acceptance is made easier.

Equally, the TA process must be transparent, balanced, and fair. For example, every participant in the project must declare any conflict of interest in whatever area, that may likely influence their judgement one way or the other. There must be balance in the representation of views, such that even contrary views must be represented. This should be a part of the project's documentation that an external reviewer or the public can access. For example, in the context of a proposed technology in land administration in Nigeria, where a member of the EG had in time past held positions in government that lead to unpopular policy decisions, such may contaminate the TA process and at the end of the day, implicate the quality of the process. Also, given the likelihood of diversity of background of participants, the rules applied in the TA process mustn't disadvantage any participant. Overall, the goal is to ensure that the overall result from the TA process is of very high quality.

VIII. Reporting:

This is the last step in the TA process and it involves submitting a final report of the outcome of the process. A standard report often includes a number of critical aspects covering the project's inception, background, methodology, analysis, and policy options. As a report may be quite extensive, shorter forms such as an executive summary or policy brief may be produced alongside. The TA report is an important resource material for immediate technology deployment as well as other ancillary purposes such as policy formulation and even law-making. The purpose of such a report is to inform policymakers as well as implementing agencies about the process, its outcomes, and recommendations. It also ensures that very important information is protected and stored for future use. Realising development needs often takes place within a time frame. Accordingly, it is important that the report include recommendations by the SC and EG as to whether and when the key findings of the process should be revised.

Political legitimization of the report is also key and so it is necessary that the entire process is conducted in close proximity with important political institutions. In the context of the deployment of blockchain technology in land administration in Nigeria, a really important institution would be the National Assembly, which represents the legislative arm at the federal level made up of a 109-member Senate and a 360-member House of Representatives. What makes this institution key is the constitutional power it holds as the principal law-making body in the country. Section 4 of the 1999 Constitution empowers it to make laws for good government and order in the country and so, if policies from a TA process would later be expected to translate into laws, that is one body that the promoters of the process must indeed, have in mind.

APPLICATION OF TECHNOLOGY ASSESSMENT TO THE RIGHT TO DEVELOPMENT

The Draft Convention on Right to Development (DCRD) for the first time solidifies the interdependence between human rights and developments, which makes it a useful document in assessing technology. There are a number of provisions under the DCRD that can be triggered to

[98] Article 4 (2), DCRD.

assess technology for fulfilling the right to development. This section addresses a number of such provisions.

The first provision to look at is Article 12 (2) which states that:

> *Each state party shall take necessary measures at the national level, and shall ensure, inter alia, equality of opportunity for all persons and peoples in their access to basic resources, education, health services, food, housing, and employment and in the fair distribution of income, and shall carry out appropriate economic and social reforms with a view to eradicating all social injustices.*[99]

This provision is relevant given that in contemporary times, technology offers immense opportunities for people to access social services such as education, employment, health, and housing, which are important indices in determining a state's progressive realization of RtD. They are also matters that developing countries such as Nigeria are struggling to deal with and are way down the pecking order in terms of global development indices. The extent to which people are able to access affordable and quality housing is a major criterion for determining a country's level of development, and where technology is well accepted and harnessed, it can enhance access to such a social service and ultimately the realization of RtD.

Equally noteworthy is Article 13 (1) (a) which states that:

> *State parties reaffirm and shall implement their duty to cooperate with each other, through joint and separate action, in order to…solve international problems of an economic, social, cultural, political, environmental, health-related, educational, technological or humanitarian character.*[100]

This provision highlights the importance of international cooperation in successful technological application by a State. Most times, the deployment of technology by States is highly capital-intensive, requiring extensive infrastructure for efficiency. Most developing countries such as Nigeria, lack the financial as well as technical capability to make this happen. Where international cooperation is adequately marshaled, it fills this gap, thereby solving problems of different character such as economic, social, environmental, etc. Matters of housing and land administration are economic and social in nature and central to realising RtD. They are also matters that developing countries can successfully deal with through international cooperation.

In most countries, Nigeria inclusive, the gains of international cooperation are realized through technology transfer, which ensures the inflow of foreign technology into the country towards adapting the same to fit domestic realities. In Nigeria, matters of technology transfer are coordinated by the National Office for Technology Acquisition and Promotion (NOTAP) a parastatal under the Federal Ministry of Science and Technology, with the mandate to evaluate register, and monitor all technology transfer agreements between Nigerian entrepreneurs, institutions, and their foreign technical partners.[101] It evaluates such agreements from three perspectives i.e., legal, economic, and technical with the goal being that Nigerian companies aren't shortchanged by such agreements. It ensures that such agreements are concluded in line with extant laws and don't contain restrictive clause. Essentially, technology transfer agreements are to

[99] Article 12 (2), DCRD.
[100] Article 13 (1) (a), DCRD.
[101] NOTAP was initially established by Decree No. 70 of 1979 as the National Office of Industrial Property. In 1982, the name was changed to NOTAP under Decree No. 82 of 1992. The Agency currently operates under the framework of the NOTAP Act, CAP N62, Laws of the Federation of Nigeria (LFN) 2004.

be registered with NOTAP, the effect of non-registration being that no payment can be made outside the country through the Central Bank of Nigeria, other licensed banks, or the Federal Ministry of Finance. However, the mandate of the Agency doesn't extend to the exportation of Nigerian technology to other countries.[102]

Despite NOTAP's work, technology transfer in the country is hindered by a lack of adequate absorptive infrastructure, a weak economy, government policies, cultural norms, etc.[103] For instance, an alternative means of international cooperation could be through the acquisition of technological skills through oversea education facilitated by foreign scholarships.[104] In times past, Nigerians have benefited from scholarships awarded by international bodies and agencies as well as privately funded overseas scholarships.[105] The main challenge here is that whereas many Nigerian nationals have acquired technology-related skills in several institutions across the world, there is often inadequate infrastructure on the ground to absorb these skills upon completion.[106]

Another hindrance to technology transfer and in extension, international cooperation is technological competition by countries. A notable example is the United Kingdom (UK) Law Commission recent 2023 report on Digital Assets, in which it recommended reforms to laws applicable to the validity and use of crypto-token networks in the country.[107] The report notes that "*some digital assets are neither things in possession nor things in action, but that nonetheless the Law of England and Wales treats them as capable of being things to which personal property rights can relate*".[108] The implication is that every holder of crypto-tokens can claim the performance of the obligations recorded by the crypto-token. This challenges a major area of international cooperation, which is in the area of securing intellectual property rights across borders.[109] While the proposed reform in this report seeks to protect the interest of UK rights holders, it doesn't take into consideration the UK's obligation in terms of international cooperation, which is to seek common ground with other countries on protecting property rights across borders. This goes to show that, despite the laudable provisions under the DCRD, technological competition amongst countries could be a major impediment to realizing RtD in developing countries such as Nigeria.

Another relevant provision is Article 13 (2) (e) of the DCRD which provides that:

State parties have primary responsibility, in line with the general principles of international solidarity and towards realizing RtD, to take deliberate steps together with international organizations and Civil Society Organizations "*to mobilise appropriate technical, technological, financial,*

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[102] *Stanbic-IBTC Holdings Plc v. Financial Report Council of Nigeria and National Office for Technology Acquisition and Promotion (NOTAP)* (2018) LPELR-46507 (CA).
[103] James A. Ejiwale, 'Breaking Impediments to Technology Transfer Through Foreign Trained Nationals' (2014) 4 (4) *International Journal of Business, Humanities, and Technology*, 54 – 63 at 56.
[104] Collins C. Ajibo, et al, 'Technology Transfer for Development in Nigeria: Patterns Problems, and Prospects' (2019) *Commonwealth Law Bulletin*, 1 – 22 at 16.
[105] *Ibid*
[106] *Ibid* at 17.
[107] *See*, 'Digital Assets' *Summary of Final Report - Law Commission*, https://s3-eu-west-2.amazonaws.com/lawcom-prod-storage-11jsxou24uy7q/uploads/2023/06/14.294_LC_Digital-assets-summary_v5_WEB.pdf
[108] *See*, 'Digital Assets' *Summary of Final Report - Law Commission*, https://s3-eu-west-2.amazonaws.com/lawcom-prod-storage-11jsxou24uy7q/uploads/2023/06/14.294_LC_Digital-assets-summary_v5_WEB.pdf
[109] Daniel Garcia-Macia and Rishi Goyal, 'International Cooperation in an Era of Technological Competition' *Journal of International Affairs* (July 18, 2021), https://jia.sipa.columbia.edu/online-articles/international-cooperation-age-technological-competition

infrastructural and other necessary resources to enable State Parties, particularly in developing or least developed countries to fulfill their obligations under the present Convention".[110]

This provision speaks directly to the fact that harnessing technology to deliver social goods is an international obligation for States. This obligation is particularly important for developing countries grappling with huge deficits in social services. In line with this obligation, it means a State must determine, through priority setting, which technological application is right to help it address and overcome its social services issues e.g., education, health, employment, or housing, and proceed to take calculated steps to mobilise such technology. Such states also have the benefit of working with international organizations and CSOs toward realizing this obligation. In this case, the DCRD is useful as it helps guide states on which technology to prioritize for adoption. Such technology must be development-driven i.e., help address the development needs of countries. For example, Article 12 (2) of the DCRD provides that

> *Each state shall take all necessary measures at the national level, and shall ensure inter alia, equality of opportunity for all human persons and peoples in their access to basic resources, education, health services, food, housing and employment, and in the fair distribution of income, and shall carry out appropriate economic and social reforms with a view to eradicating all social injustices.*[111]

Clearly, the focus of the DCRD is on the delivery of socio-economic goods and so, it means that in prioritizing the adoption of technology, how and to what extent such technology can help drive socio-economic good must be a consideration.

Also important is Article 13 (4) (g) of the DCRD which provides for:

> *Enhancing North-South, South-South, triangular, and other forms of regional and international cooperation in all spheres, particularly on access to science, technology, and innovation, and also enhancing knowledge-sharing on mutually agreed terms, including through improved coordination among existing mechanisms, in particular at the United Nations level and through existing and new mechanisms for global technology facilitation.*[112]

This provision is further strengthened by Article 13 (4) (i) of the DCRD which states that:

> *Promoting the development, transfer, dissemination, and diffusion of environmentally sound and human rights-compliant technologies to developing countries on favourable terms, including on concessional and preferential terms, as mutually agreed.*[113]

Within the same context, Article 15 (2) (e) of the DCRD equally provides for:

> *The facilitation and mobilization of financial, technical, technological, infrastructural, capacity-building, and other assistance.*[114]

These provisions represent important pillars on which the RtD framework hinges, in particular, the requirement of north-south, south south-south as well as cooperations across other levels. This is particularly instructive for developing and least developed countries, most of whom lack the

[110] Article 13 (2) (e), DCRD.
[111] Article 12 (2), DCRD.
[112] Article 13 (4) (g), DCRD.
[113] Article 13 (4) (i), DCRD.
[114] Article 15 (2) (e), DCRD.

capacity to mobilise technology on their own. For the RtD to indeed be realized, it means that technologically advanced nations of the West must be willing to cooperate with and assist developing countries in accessing technology and innovation. This can happen through direct technology transfer from such western countries of the global north to those in the global south. It could also be based on knowledge-sharing on mutual terms. To make these interactions possible, international and regional institutions are also required to play their role, by providing the necessary platforms for these countries to come together. For a country such as Nigeria, with massive infrastructural deficits, international cooperation is important for successful access to technology.

Appendix 2: Technology Acceptance Model (TAM) – Literature Review

By Olusola Babatunde Adegbite

Technology has the potential to deliver both short and long-term benefits at the individual, organisation, as well as governmental levels. Whereas traditionally, transactions between governments and their people took place in physical offices, the current thinking is how government agencies can use technology to deliver effective and efficient services to the citizens.[115] This is due to the increasing recognition that there is a connection between technological innovations, transparent governance systems, and socioeconomic development.[116] With its ever-increasing ability and ubiquity, the relationship between technology and human beings remains a critical part of daily human life.[117] Within the land administration ecosystem, technology offers great promises for improving the quality of services provided, as well as the effectiveness and efficiency of personnel working in land registries and other government establishments. Technology use in land administration can help increase access to land for the people and also make less cumbersome services such as registration of land titles, transfer of land titles, etc. Success in the implementation of technology hinges on the level of usage by the intended consumers. The extent to which technology used within a system can deliver on its promises is shaped by the level of its acceptance by the intended end users. In the context of land administration, the extent to which personnel of land registries are willing to use technology while performing their tasks will determine how much the goals of government establishments are achieved. Where the level of acceptance of technological innovation in a setting is low, this will affect the personnel's interaction with such technology, and ultimately the possibility of its benefits being accessed.

The Technology Acceptance Model (TAM) provides a theoretical framework for understanding technology acceptance and usage in a setting. Over the years, researchers in Information Systems (IS) began theorising on the best model for understanding how and what exactly makes people receptive to a particular technology. In the course of these efforts, IS investigators proposed intention models derived from the study of social psychology as a possible theoretical foundation for research in this area.[118] Founded on theories in social psychology, such as the Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB), TAM rests on the belief-attitude-intention-behaviour causal relationship, as a basis for predicting and explaining the acceptance of technology amongst potential users.[119] Developed by Fred Davis in his groundbreaking doctoral research at the Massachusetts Institute of Technology (MIT), TAM is designed as a model for explaining the consumer's acceptance of IS.[120] Put precisely, it explains the acceptance of information systems i.e., technology by individuals. As Davis notes "*a key purpose of TAM, therefore, is to provide a basis for tracing the impact of external factors on internal beliefs, attitudes, and intentions*".[121] Under the TAM model, a potential user's overall attitude towards using a given system

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[115] Mutawakilu A. Tiamiyu and Kemi Ogunsola, 'Preparing for E-Government Some Findings and Lessons from Government Agencies in Oyo-state, Nigeria' (2008) 74 (1) *South African Journal of Library and Information Science*, 58 – 72 at 58.

[116] *Ibid*

[117] Mahtab Ghazizadeh, John D. Lee, and Linda N. Boyle, 'Extending Technology Acceptance Model to Assess Automation' (2012) 14 *Cognition, Technology, & Work*, 39 – 49 at 39.

[118] Fred D. Davis, Richard P. Bagozzi, and Paul R. Warshaw, 'User Acceptance of Computer Technology: A Comparison of Two Theoretical Models' (1985) 35 (8) *Management Science*, 982 – 1003 at 983.

[119] Sejin Ha and Leslie Stoel, 'Consumer e-Shopping Acceptance: Antecedents in a Technology Acceptance Model' (2009) 62 *Journal of Business Research*, 565 – 571 at 565; Nikola Marangunic and Andrina Granic, 'Technology Acceptance Model: A Literature Review from 1986 – 2013' (2015) 14 *Universal Access in the Information Society*, 81 – 95 at 81.

[120] Fred D. Davis, *supra* at 15.

[121] *Ibid* at 985.

determines whether or not he/she will actually use it.[122] TAM was specifically designed for modelling individual acceptance of IS with the purpose of explaining their intention to use it.[123] While the original theoretical conceptualisation of TAM included the attitude construct, the final TAM model excluded the attitude construct as attitude didn't fully mediate the effect of perceived usefulness on intention.[124] Today, TAM is the most influential and commonly used theory in explaining technology usage behaviour and an individual's acceptance of information systems.[125]

In TAM, the usability of technology is distinct from its usefulness.[126] TAM takes the position that an individual's acceptance of technology is determined by two key variables i.e., 'perceived usefulness' and 'perceived ease of use'.[127] On the one hand, Perceived usefulness is defined as "*the degree to which an individual believes that using a particular system would enhance his or her job performance*".[128] On the other hand, Perceived ease of use is defined as "*the degree to which an individual believes that using a particular system would be free from physical and mental effort*".[129] TAM suggests a causal link between perceived usefulness and perceived ease of use as well as user's attitude, behavioural intention, and actual technology usage.[130] The general assumption is that while perceived usefulness directly influences intention, perceived ease of use only acts indirectly through usefulness.[131] Belief about the system, perceived usefulness, and perceived ease of use are all correlates of the eventual use of technology.[132] On this basis, it ought to be possible to predict the future use of technology by using TAM to explain the necessary variables at the time such technology was introduced.[133]

Over time, a significant body of literature has examined TAM as a whole or extended it by adding extra constructs. For instance, Rauniar, et al, test TAM evaluated in a number of contexts such as information systems, software applications, and e-commerce.[134] They also examined the new dimensions of TAM for a social media user.[135] The result from their study re-establishes the

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[122] Fred D. Davis, *supra* at 24.
[123] Kwasi Amoako-Gyampah and A. F. Salam, 'An Extension of the Technology Acceptance Model in an ERP Implementation Environment' (2004) 41 *Information & Management*, 731 – 745 at 733.
[124] Fred D. Davis and Viswanath Venkatesh, 'A Critical Assessment of Potential Measurement Biases in the Technology Acceptance Model: Three Experiments' (1996) 45 (1) *International Journal of Human-Computer Studies*, 19 – 45 at 21.
[125] Younghwa Lee, Kenneth Kozar, and Kai R.T. Larsen, 'The Technology Acceptance Model: Past, Present, and Future' (2003) 12 (50) Communications of the Association for Information Systems, 752 – 780 at 752; Daniel J. McFarland and Diane Hamilton, 'Adding Contextual Specificity to the Technology Acceptance Model' (2006) 22 Computers in Human Behaviour, 427 – 447 at 428.
[126] Robin P. Horton, et al, 'Explaining Intranet Use with the Technology Acceptance Model' (2001) 16 *Journal of Information Technology*, 237 – 249 at 240.
[127] Younghwa Lee, *supra* at 720.
[128] Fred D. Davis, 'A Technology Acceptance Model for Empirically Testing New End User Information Systems: Theory and Results' *Ph.D. Dissertation, Sloan School of Management, Massachusetts Institute of Technology (20 December 1985),* 1 – 291 at 26.
[129] *Ibid*
[130] Namkee Park, Kwan Min Lee, and Pauline H. Cheong, 'University Instructors' Acceptance of Electronic Courseware: An Application of the Technology Acceptance Model' (2007) 13 (1) *Journal of Computer-Mediated Communication*, 163 – 186 at 165.
[131] Paul A, Pavlou, 'Consumer Acceptance of Electronic Commerce Integrating Trust and Risk with the Technology Acceptance Model' (2003) 7 (3) *International Journal of Electronic Commerce*, 101 – 134 at 108.
[132] David Gefen and Detmar W. Straub, 'Gender Differences in the Perception and Use of E-mail: An Extension to the Technology Acceptance Model' (1997) 21 (4) *MIS Quarterly*, 389 – 400 at 390.
[133] Mark Turner, et al, 'Does the Technology Acceptance Model Predict Actual Use. A systematic Literature Review' (2010) 52 *Information and Software Technology*, 463 – 479 at 464.
[134] Rupak Rauniar, et al, 'Technology Acceptance Model (TAM) and Social Media Usage: An Empirical Study on Facebook' (2014) 27 (1) *Journal of Enterprise Information Management*, 6 – 30 at 8.
[135] *Ibid* at 9.

relationship between the original TAM constructs and the positive relationship between the intention to use and actual use by social media users.[136] The study also proposes that the perceived usefulness and trustworthiness of a social media site are key determinants of a user's intention to use social media, which is also the signal of the individual's actual use of social media.[137] In line with the TAM model, the study validates the attitude-intent-behaviour link in the context of the social media site Facebook.[138] With the aim of extending the original TAM model and identifying potential antecedents of technology use from the perspective of learners, Zhou, Xue, and Li, on their part explored the factors that may affect students' intention to use an online education platform at a Chinese University.[139] Their study found that perceived ease of use positively influences perceived usefulness and perceived usefulness compellingly impacts users' intention to use the online learning platform.[140] Moreso, their study identified perceived enjoyment and perceived interaction as important factors affecting users' continuous learning intention with respect to online learning.[141] McKechnie, Winklhofer, and Ennew also adopted the TAM model as a theoretical framework for identifying key factors which assist in explaining the extent of consumers' acceptance and usage of online financial services.[142] Their study found that positive attitudes about the Internet as a distribution channel for financial services, drive its use.[143]

On their part, Kim and Garrison in their study developed a model that identifies some of the important factors that lead to the acceptance of mobile wireless technology.[144] Their study found that perceived ubiquity and perceived reachability significantly and certainly impact an individual's intention to use mobile wireless technology.[145] Consistent with TAM literature, their study found a significant and positive relationship between perceived ease of use and perceived usefulness.[146] Kalayou, Endehabtu, and Tilahun in their study introduced a modified theoretical model constructed based on TAM and empirically tested it to determine the key factors influencing the intention of healthcare professionals to adopt e-health technologies in resource-limited settings.[147] They argued in their study that perceived usefulness and technical infrastructure had a greater effect than perceived ease of use on users' attitudes and intention to use e-health.[148] They, therefore, concluded that perceived usefulness and technical infrastructure are critical factors that must be taken into consideration in developing nations' e-health systems adoption.[149] Covin and Goh equally developed a theoretical model to explain why patrol officers accepted or rejected the

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136 *Ibid* at 22.
137 *Ibid* at 25.
138 *Ibid*
139 Liqiu Zhou and Sijia Xue, and Ruiqian Li, 'Extending the Technology Acceptance Model to Explores Students' Intention to Use an Online Education Platform at a University in China' (2022) *Sage Open*, 1 – 13 at 2.
140 *Ibid* at 8.
141 *Ibid* at 10.
142 Sally McKechnie, Heidi Winklhofer, and Christine Ennew, 'Applying the Technology Acceptance Model to Online Retailing of Financial Services' (2006) 34 (4) *International Journal of Retail & Distribution Management*, 388 – 410 at 390.
143 *Ibid* at 402.
144 Sanghyun Kim and Gary Garrison, 'Investigating Mobile Wireless Technology Adoption: An Extension of the Technology Acceptance Model' (2009) 11 *Information Systems Frontiers*, 323 – 333 at 324.
145 *Ibid* at 329.
146 *Ibid*
147 Mulugeta H. Kalayou, Berhanu F. Endehabtu, and Binyam Tilahun, 'The Applicability of the Modified Technology Acceptance Model on the Sustainable Adoption of eHealth Systems in Resource-Limited Settings' (2020) 13 *Journal of Multidisciplinary Healthcare*, 1827 - 1837 at 1828; Vassilios P. Aggelidis and Prodromos D. Chatzoglou, 'Using a Modified Technology Acceptance Model in Hospitals' (2009) 78 *International Journal of Medical Informatics*, 115 – 126 at 116.
148 Mulugeta H. Kalayou, *Ibid* at 1832.
149 *Ibid*

Mobile Display Terminals (MDTs) technology in the course of policing.[150] In their study, information quality and timeliness emerged as important variables accounting for unique training, roles, activities and responsibilities of patrol officers, while less important roles were ascribed to the main variable of TAM i.e. perceived usefulness and perceived ease of use.[151] According to their study, this is due to the nature of police work, which dictates attributing importance to the quality and timeliness of information, given the potentially dangerous environment in which police officers perform their work.[152]

Koul and Eydgahi on their part examined whether there is a relationship between the perceived usefulness of driverless car technology, perceived ease of use of driverless car technology, years of driving experience, age, and the intention to use driverless cars.[153] Their study showed that as the perceived usefulness associated with driverless cars increased, the intention of consumers to use driverless cars strongly increased, while as the perceived ease of use of driverless cars increased, the intention of consumers to use driverless cars moderately increased.[154] They, therefore, suggested that the perceived usefulness construct be deployed as a main focus area for marketers of driverless technology.[155] Park, Nam, and Cha in their work extended TAM by studying university students' mobile learning (m-learning) acceptance and intention to use.[156] Their study showed that the TAM construct played both direct and indirect effects on university students' behavioural intention to use m-learning.[157] In the same vein, Fussell and Truong extended TAM by examining students' intention to use Virtual Reality (VR) technology for training purposes.[158] Their study demonstrated that TAM is a useful tool for understanding how students perceive using VR in a dynamic learning environment.[159]

With respect to the application of TAM in land administration or digitizing land governance in Nigeria, progress in this area can be measured through the lens of developments in the country's e-government framework. In Nigeria, such a framework is still relatively weak and bedevilled with all sorts of challenges. In a study on the level of awareness of technological innovations in land administration in Nigeria's Federal Capital Territory (FCT) Fateye, et al, for example, found the level of awareness low, suggestive of the fact that land administration is at its basic level and depends on labour intensity, rather than technologies.[160] Compared to what obtains in other climes, this rudimentary approach hasn't yielded much fruit.[161] Other scholars have equally examined the threats to e-government services in the country. For instance, Azeez, et al, have identified challenges such as a lack of IT experts, a dearth of infrastructure, energy and electric power issues,

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[150] Caran A. Colvin and Angeline Goh, 'Validation of the Technology Acceptance Model for Police' (2005) 33 *Journal of Criminal Justice*, 89 – 95 at 90.
[151] *Ibid* at 94.
[152] *Ibid*
[153] Sahil Koul and Ali Eydgahi, 'Utilizing Technology Acceptance Model (TAM) For Driverless Car Technology Adoption' (2018) 13 (4) *Journal of Technology Management & Innovation*, 37 – 46 at 37.
[154] *Ibid* at 43.
[155] *Ibid*
[156] Sung Youl Park, Min-Woo Nam, and Seung-Bong Cha, 'University Students' Behavioural Intention to Use Mobile Learning: Evaluating the Technology Acceptance Model' (2012) 43 (4) *British Journal of Educational Technology*, 592 – 605 at 594.
[157] *Ibid* at 603.
[158] Stephanie G. Fussell and Dothang Truong, 'Using Virtual Reality for Dynamic Learning: An Extended Technology Acceptance Model' (2022) 26 *Virtual Reality*, 249 – 267 at 250.
[159] *Ibid* at 260.
[160] Tosin B. Fateye, et al, 'Technological Innovations in Land Administration System (LAS): Concern on Level of Awareness in Nigeria' (2020) 14 (2) *International Journal of Real Estate Studies*, 140 – 155 at 153.
[161] *Ibid*

fraud, cost of IT equipment and a poor maintenance culture, and a lack of government IT regulatory policy.[162] A similar study by Abolade, Dugeri, and Adama, on the digitization of land administration in Kaduna state Nigeria revealed challenges such as a lack of financial resources, shortage of trained personnel, poor power infrastructure and low internet connectivity.[163] Olumoye and Govender in their investigation of the implementation of e-government in Nigeria's housing and urban development sector identified challenges such as remuneration of IT personnel, capacity building and training, security and privacy, the digital divide, and the readiness of the community to use ICT.[164] These threats can be validly linked to the application of TAM in land administration and governance in Nigeria, given it is a subset of the broader e-government framework.

[162] N.A. Azeez, et al, 'Threats to E-Government Implementation in the Civil Service: Nigeria as a Case Study' (2012) 13 (1) *Pacific Journal of Science and Technology*, 398 – 402 at 400, 401.

[163] A.O. Abolade, T. Dugeri, and J.U. Adama, 'Challenges of Digitalizing Land Administration System in Nigeria: The Kaduna State Experience' (2018) *The 18th AFRES Annual Conference*, 67 – 82 at 77.

[164] Mosud Y. Olumoye and Irene Govender, 'An Empirical Investigation of Factors Influencing Integrated e-Government Implementation in Nigeria: A Case of Housing and Urban Development Agency' (2018) 84 (1) *The Electronic Journal of Information Systems in Developing Countries*, 1 – 13 at 9.

Appendix 3: Technical Requirements for Blockchain Application in Land Governance in Nigeria

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Status: Approved

Approved by: Dr. Hock Gan

1.0 Introduction

1.1 Purpose

Land administration system (LAS) in Nigeria is far from being perfect. Cumbersome and outdated bureaucratic processes and high cost of services, among other challenges, bedevil this important service delivery. These challenges have ensured that a large percentage of landowners do not have sufficient government-issued land documents to prove ownership of their lands. With lack of proper documentations, a landowner who might also be a farmer will find it difficult to access much-needed finance using his land as collateral.

Sizeable parts of the low-income earners, especially the women, in Nigeria have been prevented from participating in this space due to these bottlenecks. Moreover, many litigations keep popping up on determining the true owner of a particular land. Therefore, various stakeholders have over the years proposed the use of technology to aid land administration service delivery in order to unlock the immense potentials in proper land registration and ease of transfer of ownership. Notable among the proposed technologies in recent times is the blockchain. The public, permissionless blockchain technology comes with features such as immutability of transactions, decentralisation, transparency, peer-to-peer and privacy-protection, which are necessary to drive economic development through improved land administration system.

The purpose of this document is to describe the technical requirements necessary to demonstrate the application of blockchain technology in land administration in Nigeria to all stakeholders in this project. In addition, this document would communicate, in detail, the use cases on which this research is focused. The use cases would determine the features and functionalities that the minimum viable product (MVP) that will be built would have. Four use cases (Figure 1, 2 and 3) in land administration have been identified in which blockchain can be applied to enhance service delivery. This research will study and develop a blockchain-powered solution that is applicable in these use cases.

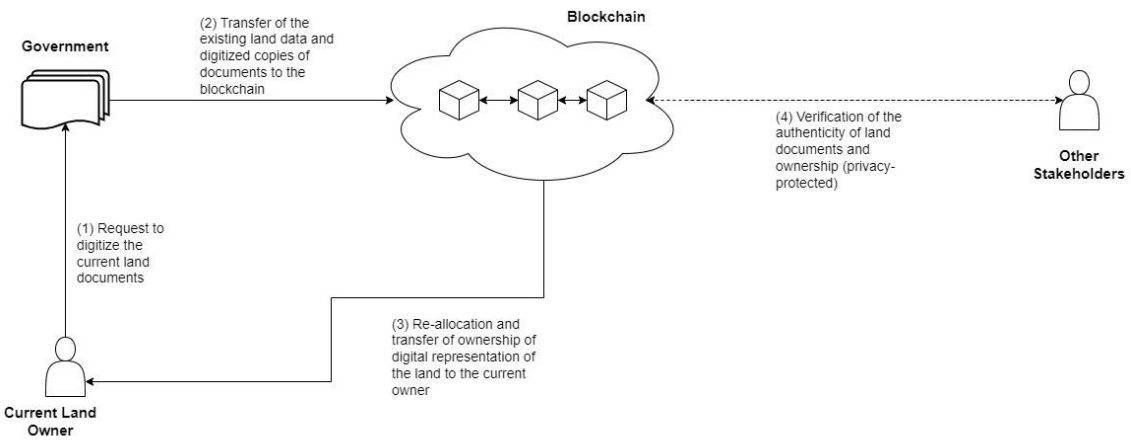

Figure 1: Use case 1 – land re-registration (including existing documents digitization) and land re-allocation to the current owners

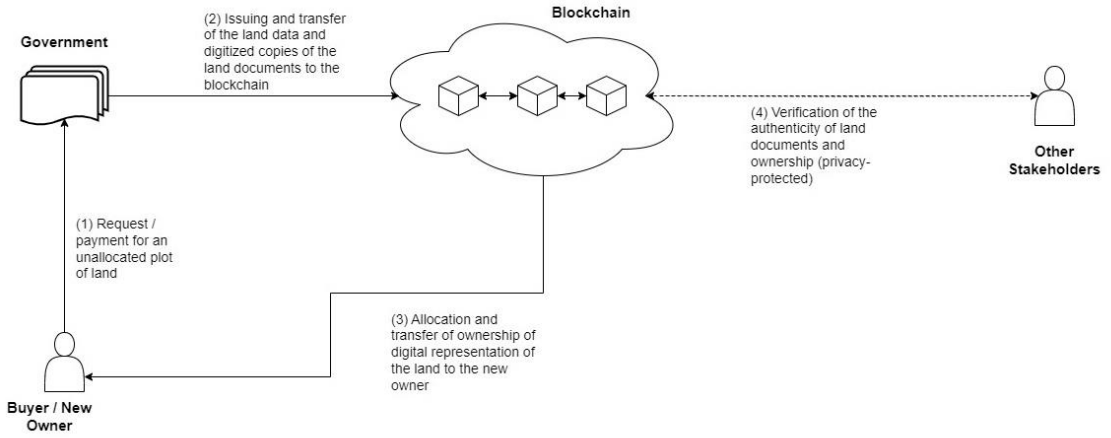

Figure 2: Use case 2 – land registration and allocation to an individual or entity on the blockchain

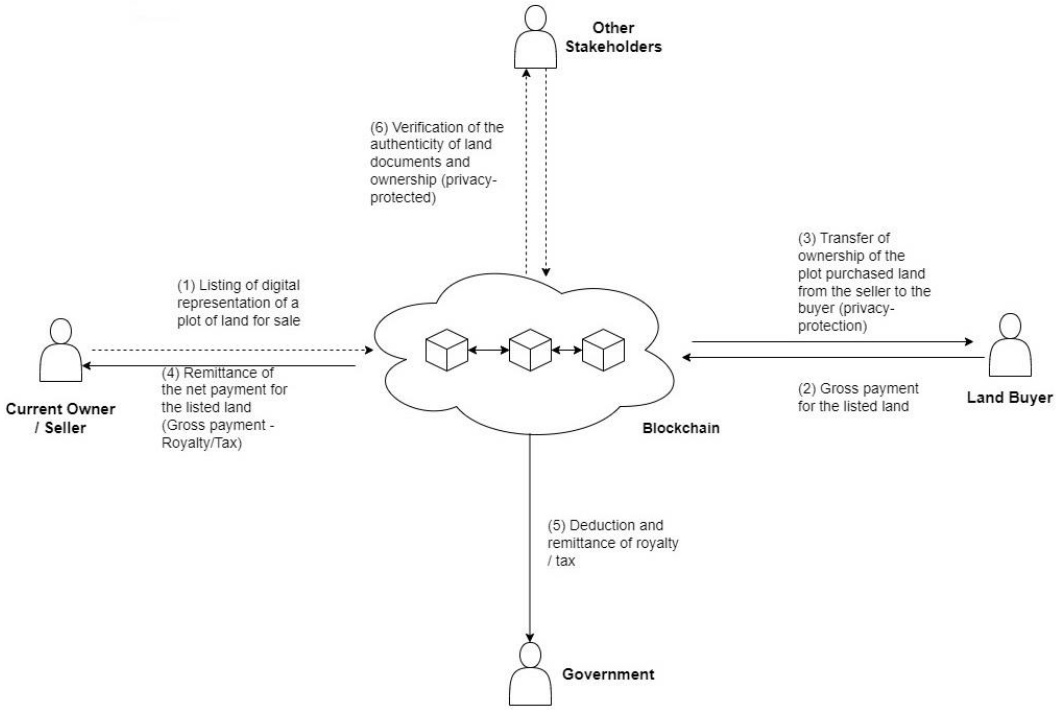

Figure 3: Use case 3 – sales and transfer of land ownership (secondary market) on the blockchain

Table 1: Legend for Figure 1, 2 and 3

——————▶	Transfer of value / digital documents
----------▶	Transfer of information

2.0 Intended Audience and Use

The deliverables from this research will serve as minimum viable product (MVP) to demonstrate the application of blockchain technology in land administration service in Nigeria. This MVP will allow a centralised authority like the law-office to generate unique digital representations of lands on the blockchain. Government will be able to re-register an existing land title and re-allocate it to the current owner on the blockchain (figure 1, use-case1). The MVP will allow the law-office to register new unallocated portions of land and securely allocate them to individuals or entities (figure 2, use-case 2) on the blockchain.

In addition, the product will allow individual landowners to take ownership of all the necessary documentations, will allow landowners to have full discretion over their lands and will facilitate financial transaction and transfer of ownership to be made on the lands in a decentralised and transparent manner (Figure 3, use-case 3). At any point in time, the various stakeholders will be

able to verify the authenticity of a land title and ascertain the true landowner while not seeing sensitive information to protect the privacy of the landowner. Moreover, the law-office (or the issuing body) will be able to collect tax or royalty on every transaction that takes place on the registered lands in the secondary market.

2.1 Project Scope

This research aims to develop a minimum viable product to demonstrate how blockchain technology can be used in the land administration system in Nigeria. Four use cases have been identified and these will be explored in detail. The use cases are described below;

- Use case 1 (Figure 1): land re-registration (including existing documents digitization) and land re-allocation by the law-office to the current owners on the blockchain.
- Use case 2 (Figure 2): land registration and allocation by the law-office to the individuals or entities on the blockchain.
- Use case 3 (Figure 3): sales and transfer of land ownership (in the secondary market) on the blockchain.
- Use case 4: handling dispute between parties regarding land ownership.

The objectives of this research are listed below;

1. To develop digital representation of lands on blockchain that can facilitate land registration in use cases 1 and 2 above.
2. To create blockchain-based secondary market for users to buy and sell land parcels in a transparent and decentralised way.
3. To facilitate land transfer of ownership for personal reasons and for monetary value. Personal reasons may include inheritance and gift.
4. To develop functionalities in the contract to handle land ownership disputes.
5. To develop a basic user interface for stakeholders to interact with the blockchain solution (MVP) developed above.

3.0 Overall Description

Use cases 1 and 2 are primarily concerned with land registration and ensuring seamless connection between the existing land administration system and the blockchain-powered solution. The blockchain solution (minimum viable product) that will be built would provide an admin access

with which a government entity can upload the lands data on-chain, engrave the data on digital tokens and assign the tokens to the verified owners.

In the third use case (use case 3), the landowners would have full discretion over the allocated digital representation (tokens) of lands issued by the law-office in the use case 1 or 2. These tokens, though publicly available, would only reveal insensitive information about the current owner and previous owners. This way, privacy of the landowners is guaranteed. A secondary market for buying and selling land parcels would be developed to for users to buy and sell genuine (government approved) land parcels in a decentralised, transparent and verifiable way. Moreover, the contract will provide a functionality to transfer land ownership for personal reasons in which no monetary value is received in exchange for a land ownership transfer. This feature is quite important in cases in which the landowner is transferring land for inheritance purpose or as gift to another person or party.

Another important feature that will be implemented in this minimum viable product is the functionality that ensures taxes and fees are collected on specified typed of transactions on these land parcels and remitted to the law-office' designated address or wallet.

Finally, since blockchain transactions are immutable and final, all transactions on the law-office issued digital land tokens will be permanent, immutable and irreversible. However, for use case 4, a validator role will be defined and assigned to an independent stakeholder such as the judiciary to work with an Admin role to settle land related disputes that may arise.

Stakeholders can interact with the blockchain at any time to get the state of the allocated land parcels.

3.1 Users' Needs

The main users of this product will be the law-office, landowners and other stakeholders including banks, institutions, agencies and potential buyers.

Government needs a product that seamlessly interface with the legacy land administration system (LAS), that is immutable and that provides cost-effective means of land registration and transfer of ownership.

Landowners (individuals and entities) cares about having full discretion over their lands and land documentations. They want to be able view and prove the ownership of a particular land while still protecting their privacy. Other stakeholders, most of the time, are interested in verifying the authenticity of a land document and determining the rightful owner in order for them to offer a particular service to the owner.

All these competing requirements will be studied under the four identified use cases depicted in the figures above and appropriate solution with the desired features will be generated and demonstrated.

3.2 Assumptions and Dependencies

These are the assumptions that largely depends on the capability of the law-office to provide relevant, appropriate and accurate input land data for the blockchain solution that will be developed;

1. Government has clear and concise data on the location, boundary and size of every land. This will allow every portion of land to be represented as a unique, non-fungible entity that can only be held by an individual or an entity at a particular point in time.
2. The existing legacy system is sufficient for the law-office to ascertain the current landowner so that the land can be re-allocated to the rightful owner on the blockchain.
3. Government issued land documents does not or is reviewed not to contain sensitive detail (e.g name and address) about the owner to guarantee his privacy. Even though every transaction on the public, permissionless blockchains are performed anonymously, it is publicly available, traceable and verifiable. Anyone can access all the transactions and the smart contracts.
4. Government and landowners have access to wallets. Wallet is a browser extension that holds an individual's account on blockchain and even provides a gateway through which one can connect and interact with the blockchain.

4.0 System Features and Requirements

To interact with the blockchain solution, a basic user interface will be developed. This UI will be used to demonstrate the performance of the MVP in the four use cases described above.

To test this product, the smart contract implementation of the solution will be deployed to a public (blockchain) testnet. Stakeholders will require a wallet (preferably Metamask) to connect to the product and interact with the blockchain. These system features are necessary for a user to interact with the MVP.

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Figure 4 The legal research team alongside a piece of 'Land Art' at Landmark Beach, Victoria Island, Lagos. June 2023

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