PUBLIC PROCUREMENT, CORRUPTION AND BLOCKCHAIN TECHNOLOGY: A PRELIMINARY (LEGAL) INQUIRY

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ABOUT THE AUTHOR

Sope Williams-Elegbe was born in Geneva, Switzerland, on 9 August 1975 to Chief FO and Barrister Kemi Williams. Her primary education was split between Geneva and Lagos, and she obtained her high-school diploma from Queen's College, Lagos, with seven distinctions. She graduated with an LLB from the University of Lagos, an LLM (with distinction) from the London School of Economics and Political Science, and a PhD from the University of Nottingham, United Kingdom.

Sope has had a varied career. She started out as a lecturer at the University of Stirling, Scotland, in October 2000. Between 2003 and 2011, she worked at the University of Nottingham, after which she relocated to Nigeria, where she served as head of research at the Nigerian Economic Summit Group from 2012 to 2014. Between 2012 and 2016, she was also a research fellow in Stellenbosch University's Department of Public Law. In 2014, Sope was appointed senior lecturer at the University of Lagos. She moved to South Africa in July 2016 and took up a post as associate professor in Stellenbosch University's Department of Mercantile Law. She was promoted to full professor in July 2017, and is currently also the interim head of department.

Sope has written two books: *Fighting Corruption in Public Procurement* (2012) and *Public Procurement and Multilateral Development Banks* (2017), co-edited *Public Procurement Regulation for 21st Century Africa* (2018) with Geo Quinot, and published 43 book chapters and peer-reviewed journal articles. She is working on her fourth book, *Corruption in SA: Public Sector Criminality and Abuse of Office*, and has had her research cited by the Constitutional Court of South Africa in the 2008 case of *Shaik v The State*. In 2014, she received Stellenbosch University's Vice-Rector's excellence award for her notable contribution to research publications.

Sope has consulted for various governments and organisations, including the World Bank, the Inter-American Development Bank, the Organisation for Economic Cooperation and Development (OECD), the United Nations Development Programme (UNDP), the United Nations Economic Commission for Africa (UNECA) and the United Nations Office on Drugs and Crime (UNODC). She currently trains investigators from the Office of the Public Protector of South Africa and is a member of Transparency International's working group on debarment as well as an editor for various academic journals.

Sope is married to Dayo and has two daughters, Ifeoluwa and Olutofarati. Her siblings are Mrs Seyi Oshikanlu (adviser to the Nigerian minister of trade), Prof Bisi Ademuyiwa (associate professor of medicine at Washington University, St Louis) and Mr Ben Williams (associate at Vedder Price LLP, Chicago).

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I. INTRODUCTION

My journey as an academic began almost 18 years ago to this day, when I joined the University of Stirling on 30 October 2000. However, my academic interest in public procurement began in 2003, when I moved to the University of Nottingham and was assigned a senior colleague, Prof Sue Arrowsmith, as a mentor. Sue is one of the world's leading experts in public procurement, and within a year, her relentless proselytisation of her work convinced me that I needed to adopt public procurement as my primary research area.

As a scholar interested in public procurement, I was unable to escape the empirical and anecdotal evidence of the increasing manifestations of corruption in public procurement, especially in Africa, and in 2006, I undertook doctoral studies to examine whether debarring (excluding) corrupt contractors from government contracts was a useful way of addressing procurement corruption.

In the past five years, my interest in public procurement and anti-corruption has gone through highs and lows as I became frustrated with the futility of traditional legal responses to procurement corruption. As a result, my research has turned to innovative ways in which we can address procurement corruption in systemically corrupt societies. Recently, as the media hype about blockchain technology became more voluble, driven mostly by the fluctuations in the value of Bitcoin, I have begun to consider whether blockchain could be a viable solution to the intractable issue of procurement corruption. This lecture is a reflection on the role that blockchain-based platforms could play in public procurement in Africa.

This lecture is given with the caveat that I do not claim to be a technical expert, and so I will present the information in the least technical way possible. Also, because this is a relatively new area, this lecture is futuristic in its approach. Although blockchain technology has been around for a while, it has only recently become accessible, and its embryonic nature means that its functionalities are also neoteric.

The lecture is divided into five sections: First, I will examine what blockchain is and how it works. Next I will look at the relationship between corruption and public procurement. The lecture will then consider smart contracts and how they can be used in public procurement. Finally, I will explore the legal challenges that might be faced in conducting public procurement via a blockchain platform.

II. WHAT IS BLOCKCHAIN TECHNOLOGY?

The creation of blockchain technology is credited to a person or group of persons going by the name of Satoshi Nakamoto. It is believed that this is a pseudonym, and the true identity of Nakamoto is unknown. Although Nakamoto developed the blockchain in 2009, as early as 1991, there had been academic work on how to secure information in blocks in a manner similar to blockchain.[1] However, Nakamoto is credited as the creator of blockchain, having actually built the technology.

Blockchain can be defined as "a database, a way of storing records of value and transactions".[2] This definition, though accurate, does not provide an insight into why blockchain is regarded as revolutionary or even interesting. What makes blockchain technology fascinating, is that it is both a digitised and a decentralised public ledger of transactions.[3] It is "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way".[4] A distributed ledger allows any number of computers to keep an identical record of information, without having to reference a master copy.[5] In other words, every copy of the record that is kept by the computers on the network is identical. This means that the record of information or transactions cannot be altered by any of the participating parties, unless it is altered by all. I am sure you can already imagine the benefits of such a platform.

The data or transactions in a blockchain are stored in a "block". Each new block is linked to the previous block in a logical sequence and recorded in chronological order, without the need for a centralised record-

keeping system. A single transaction or record cannot be deleted or amended unless the entire chain of blocks sequential to that transaction are also rewritten.[6] As each transaction submitted to the block is added only after it has been verified as legitimate by the participants, this almost completely eliminates the possibility of fraudulent transactions.

All blockchains work in the following way: Identical copies of a database are shared amongst a community of participating computers called nodes. When a party wants to execute or record a new transaction, a request is sent to the network, where it is received for processing by the nodes. A consensus algorithm, administrator or sub-group of participants determines whether the request is authentic. If so, the ledger is automatically updated with a new "block" of data.[7] Where a blockchain platform is public, this makes it easy for anyone to query any block[8] of the shared public ledger of transactions.[9]

Iansiti and Lakhani explain that in blockchain-based platforms, transactions and contracts can be "embedded in digital code and stored in transparent, shared databases, where they are protected from deletion, tampering, and revision. In this world, every agreement, every process, every task, and every payment would have a digital record and signature that could be identified, validated, stored, and shared. Intermediaries like lawyers, brokers, and bankers might no longer be necessary".[10]

As a lawyer, I certainly hope it does not come to that, but the truth is that this technology is able to democratise contracting in a way that might obviate the *need* for certain types of intermediaries, such as estate agents and, yes, in some cases, lawyers!

For instance, consider a situation where land titles are stored in a blockchain registry. This means that all ownership and encumbrances on a title are transparent, cannot be tampered with, and do not need to be "searched" or verified by an intermediary. Property transactions become safer and are no longer prone to fraud. In some developing countries, conflicting land titles and ownership present a real challenge to property transfers, and a blockchain system completely eliminates this risk. Blockchain is currently being used to register land titles in India, Honduras, Georgia, Sweden, Brazil, Rwanda and Ghana; and Dubai intends to move all government services to a blockchain platform by 2020.[11]

Blockchain technology was developed to support Bitcoin, which is its most popular and notorious application, but certainly not its most useful or even viable. Bitcoin is a virtual or digital currency that is referred to as a cryptocurrency[12] because of its inherent cryptographic security. As a currency, Bitcoin can be transferred and spent without the need for an intermediary such as a commercial bank, or a payment gateway such as PayPal. Bitcoin enables bilateral financial transactions on a platform that is open, distributed and "trustless,"[13] in the sense that transactions are possible without the presence of a trusted third party or institution[14] such as a bank. Parties do not have to provide for the risk of not being able to trust a contracting party because the blockchain permits a transaction only after it has been verified by other users. Blockchain allows peer-to-peer transacting, which eliminates the need for a central authority for "issuing currency, transferring ownership and confirming transactions".[15]

According to Kiviat, blockchain is revolutionary for various reasons: "Because it is an authentication and verification technology, it can enable more efficient title transfers and ownership verification. Because it is programmable, it can enable conditional 'smart' contracts. Because it is decentralized, it can perform these functions with minimal trust without using centralized institutions. Because it is borderless and frictionless, it can provide a cheaper, faster infrastructure for exchanging units of value."[16]

i. Authentication and verification

Where two people transact on a blockchain network, for instance to transfer Bitcoin, the transferor sends a message to the network about the transaction. The receiver sends a message accepting the transaction, and asking the network to authenticate and verify it. This verification by majority decision[17] is referred to as the "proof of work" and is essentially a competition among network participants to validate transactions.[18] Users within the system are incentivised to bear the computational costs of validation, as successful participants are rewarded with new Bitcoin.[19] Validation reduces the need to rely on third-party intermediaries, and once the transaction is verified, the transaction block is updated to reflect it.[20]

ii. Programmable

Transactions conducted on a blockchain can be programmed, meaning that an algorithm can be created "that would automatically trigger a transaction at a certain point … or automate processes to be added to the blockchain".[21] This is possibly the most exciting aspect of blockchain: It allows for the execution of "smart contracts", where an algorithm creates a conditional contract, and when the contract conditions or milestones are met, it triggers other processes, such

as payment. The functionality of the blockchain could be used to register, confirm and transfer all manner of property[22] without the need for intermediaries, thus changing the way in which transactions are concluded.

iii. Decentralised

A noteworthy aspect of blockchain is that each participant on the platform has access to the entire database and its complete history.[23] Thus, no single person controls the data or information, and each person is able to verify transactions as described above. Whilst traditional, centralised data storage may be more resource-efficient, it is also more vulnerable, as hackers need only access the main server to wreak havoc. The Equifax breach in 2017 is a case in point, where hackers accessed the personal and financial records of 143 million people in the United States, United Kingdom and Canada. The decentralised data storage of a blockchain platform means that the database is distributed across the computers of all participants in the network.[24] The control of the data does not rest with or belong to a single party,[25] which makes hacking extremely difficult, as the information is not being routed through a single server.[26]

iv. Borderless and frictionless

Traditional transactions usually require the presence of intermediaries, who provide the trust required for participants to proceed. Their presence increase transaction costs and can cause delays. However, blockchain facilitates direct, peer-to-peer transacting, which reduces transaction costs and the friction caused by having to rely on intermediaries. Blockchain establishes trust between the parties to a transaction, both through the decentralised public ledger and a cryptographic mechanism that prevents transactions from being changed after the fact.[27]

Next we will examine the relationship between public procurement and corruption, and later, the scope for procurement via a blockchain platform.

III. PUBLIC PROCUREMENT AND CORRUPTION

Public procurement is the process by which a government buys the goods, services and works needed to fulfil its functions and maximise public welfare. It is an intrinsic aspect of the public financial management system and cannot be divorced from budgeting, accounting and governance systems. The importance of public procurement, however, lies in the fact that it is the main conduit for government expenditure, apart from grants and social programmes. In South Africa, the annual procurement spend is R800 billion, and it is estimated that about 50% of this figure might be lost to corruption.

There is a plethora of literature on corruption in public procurement.[28] The literature covers issues such as the typology and extent of corruption in public procurement, the areas at risk of corruption in the procurement process, and measures to address this corruption.[29] Campos and Pradhans provided indicators of red flags in a procurement process,[30] and their work illustrated that almost every point in a procurement process is at risk of corruption. Whilst there are measures that may be put in place to limit these risks, many of them cannot be eliminated.[31] In countries with systemic corruption, it is even more difficult to address corruption in public procurement, given that in such countries, the anti-corruption framework is itself corrupted and prone to manipulation by the corrupt.[32]

Corruption in public procurement is enabled by the reliance on intermediaries (public officials) in the procurement process, often referred to as the agency problem.[33] From deciding which projects to approve, to the specifications of what is to be bought, and the evaluation of tenders – contract award decisions could be manipulated in several ways. These include a lack of transparency, adopting a contracting process that dissuades competition[34] or is in effect a *fait accompli*, and the failure to publicise or give reasons for decisions. Contract implementation, monitoring and payment also present several opportunities for corruption.[35]

A common way of addressing the agency problem in public procurement is to limit the discretion available to public officials in decision-making, provide multiple approval levels, and develop an enforcement framework to sanitise the procurement process.[36] These are similar to the solutions that blockchain provides in relation to Bitcoin: maintaining trust and preventing fraud in payments, without relying on third-party intermediaries to limit the risk of dishonesty on the part of transacting partners.

In public procurement, we use various mechanisms to prevent corrupt contractors from participating in a tenders process. These include requiring contractors to provide documentary evidence to verify their identity (tax and registration records), requiring registration with the chamber of commerce or on a government database, requiring the exclusion or debarment of contractors who have previously proven to be

unethical,[37] and requiring affidavits of compliance with various regulations such as those pertaining to modern slavery and money laundering. This shows the reliance on third-party intermediaries to provide assurance in the procurement process.

In relation to public officials, we require them to declare and avoid conflicts of interest, record procurement proceedings, publish relevant information, and meet certain standards of professionalism and ethics. However, these safeguards have not resulted in significant reductions in the level of corruption in public procurement. In South Africa, 50% of the complaints submitted to the Office of the Public Protector refer to problems with the public procurement process, and recent Auditor-General's reports have highlighted immense increases in fraudulent expenditure linked to procurement spending.[38] This illustrates that these measures on the part of the public and private sector do not fully address the corruption problem.

The rest of this lecture will discuss contracting using blockchain technology ("smart contracts"), and explain how this may address procurement corruption.

IV. CONTRACTING USING BLOCK CHAIN: "SMART CONTRACTS"

Smart contracts are blockchain transactions that go beyond cryptocurrency or payments, and have more extensive instructions embedded in them.[39] As mentioned earlier, the blockchain is programmable, meaning that an algorithm can be created "that would automatically trigger a transaction at a certain point … or automate processes to be added to the blockchain".[40]

A smart contract is a contract that is formed and performed (often using cryptocurrency) via the blockchain.[41] Contractual terms are converted into a computer code, and this code is uploaded to the blockchain and the system acts in accordance with the code to execute the contract.[42] Werbach and Cornell define a smart contract as "an agreement in digital form that is self-executing and self-enforcing,"[43] while Raskin describes it as an agreement "wherein execution is automated ... Automation ensures performance, for better or worse, by excising human discretion from contract execution".[44]

In traditional contracts, the parties agree to do or refrain from doing something on particular terms. Depending on the jurisdiction, something of value may be required in exchange for this promise.[45] The parties to the contract have to trust that the other contracting party will act in accordance with the terms of the contract, and provisions are included in the contract to mitigate the risk of breach and provide penalties when this occurs. Smart contracts operate in the same way, in the sense that there is an agreement between two or more parties, but "they remove the need for one type of trust between parties. This is because a smart contract is both defined by the code and executed (or enforced) by the code, automatically, and without discretion".[46]

Smart contracts have been likened to the transactions that we conduct with vending machines.[47] In such contracts, once a condition is fulfilled: the selection of the required item and the insertion of payment, the machine has no discretion as to whether to perform or not. These contracts are irreversible, and as long as there is no mechanical fault, the machine performs according to its program. There is no need for you to "trust" in the vending machine as there is no option for it not to perform the contract once the required conditions are met. Unlike a person, a vending machine behaves algorithmically; the same instruction set will be followed every time in every case,[48] and will yield the same outcome. When you deposit money, and make a selection, the item is released and there is no possibility of the machine not complying with the instructions, or only partially complying.[49] Similarly, a smart contract cannot help but execute the prespecified code[50] or algorithm, and does not require the presence of an intermediary such as a lawyer to ensure that the contractual terms are complied with, or to verify or confirm ownership of assets.[51]

The use of smart contracts presents many distinct features that are not inherent in traditional contracts. These are trust, irreversibility, autonomy, and decentralization. In relation to trust, because the contract is digitally verified and authenticated by the blockchain, there is no need for you to know or trust the other contracting party. Documents are digitally signed and funds (i.e. cryptocurrency) can be placed in escrow on the blockchain,[52] and released according to the terms of the contract.[53] Irreversibility means two things: first, that the smart contract is executed in terms of the code and cannot be stopped; and second, that the record of a transaction on a blockchain cannot be altered; in other words, the records are immutable.[54] The irreversibility of the contract presents one of the greatest challenges to the adoption of smart contracts, as these contracts cannot be re-negotiated, rescinded or breached as is possible with traditional contracts. Autonomy means that after a smart contract is launched, it becomes independent, and no longer requires further contact between the contracting parties.[55] Smart

contracts are thus self-executing and self-enforcing.[56] In terms of decentralisation, we have already discussed that the blockchain is a decentralised record of information, data and transactions. Smart contracts are also decentralised in that the record of transactions is not kept in a centralised server, but is distributed among all participants in that system.[57] Therefore, every party can verify the record of every transaction in the system.[58]

These four attributes of smart contracts can potentially alter the nature of contract formation and execution. Formation no longer requires the extensive use of lawyers, as contract terms are particular to the transaction and programmed as code. The contract does not have to be policed for performance either, as it is self-executing. Irreversibility potentially means that the contract cannot be rescinded or breached by the default of the parties, and contract completion is assured.

However, smart contracts create other problems for contract law. All jurisdictions contain certain requirements for the validity of a contract. These include requirements such as contractual capacity, legality, certainty, consideration (in common-law jurisdictions) and the absence of vitiating circumstances such as duress, undue influence and unconscionability. The presence or absence of prohibited or required factors will make the contract void or voidable. Smart contracts, however, do not provide for moderation on these issues as the code self-executes, even if vitiating factors are present.[59] In the words of Raskin, "a smart contract asks its parties to tie themselves to the mast like Ulysses and ex ante commit to abiding by the terms of the agreement".[60] Unlike traditional contracts, the performance of which can be stopped by the parties or by a court, a smart contract must, by definition, execute once initiated, which means that a court confronted with a smart contract may be helpless to stop it.[61]

Smart contracts thus present difficult issues that all legal systems will need to grapple with. How can a legal system that relies on documents and testimony to understand transactions, comprehend and interpret a contract written in code? More importantly, how can a court undo a transaction that is self-executing and is "irreversibly encoded on a distributed blockchain",[62] where there is no technical means, short of undermining the integrity of the entire system, to unwind a transfer?[63] The answer may lie within smart contracts themselves, as it is possible to incorporate logic into a smart contract that allows for various exceptions or conditions.[64]

Another issue is determining how to reify remedies for smart contracts. Contract law remedies might have to be adapted where rescission is no longer possible and specific performance is unnecessary.

V. USING SMART CONTRACTS IN PUBLIC PROCUREMENT

We have said that smart contracts permit parties to transfer digital assets of value directly, without any institution acting as an exchange intermediary.[65] In public procurement, there are several intermediaries, that present a problem for probity in the procurement process. First, we have the procurement officials, who act as an intermediary for the government (who in turn acts as the intermediary for the people). In addition, we have institutions that provide assurance on the integrity of contractors, such as chambers of commerce. Further, in construction procurement, actors such as engineering consultants act on behalf of both the public and the private sector. In terms of public procurement corruption, issues arise primarily because of the agency problem and the asymmetry of information,[66] and smart contracts can alleviate both of these issues.

The challenge is then to decipher how procurement may be executed and regulated using blockchain. The public procurement system may take its inspiration from the private sector, which is already increasingly relying on blockchain technology for supply chain management. In 2016, for instance, Walmart, Nestlé and Unilever established a Food Trust blockchain system to track food in their supply chains. This is expected to improve their "ability to identify issues involved with food recalls, such as tracing outbreaks more quickly to limit customer risk".[67] In September 2017, the world's largest pharmaceutical companies also announced the blockchain-based MediLedger project, which aims to track medicines and prevent counterfeit medicines from entering the supply chain to patients.[68] The increasing adoption of blockchain and smart contracts has been said to "embody a trend toward greater machine autonomy. Insofar as computers can increasingly take the place of humans in negotiating, forming, performing, and enforcing contracts, contracts can increasingly operate with the speed and consistency of machines".[69]

According to Deloitte,[70] the four "pain points" for private-sector supply chains are traceability, compliance, flexibility and stakeholder management, and these issues are similar to those experienced by public procurement systems in a multi-layered context. The private sector is discovering that these issues can be addressed by the blockchain.

Firstly, traceability refers to the ability to monitor events and metadata associated with a product.[71] In the public procurement context, it refers to the ability to monitor contractors' performance across the entire public procurement system. This capability is not available in the procurement systems of developing countries, where paper-based systems mean that government departments operate in silos – an issue that affects the efficiency of public purchasing.

Secondly, compliance refers to the imposition of standards and controls to provide evidence that regulatory conditions are being met.[72] In the public procurement context, ensuring bidder and contractor compliance with various laws, such as those pertaining to corruption, tax, environmental protection and black economic empowerment, is a major reason for the convoluted regulation that the procurement process is subject to. Blockchain may provide a less burdensome means for ensuring compliance in a manner that eliminates the risk of fraud.

Thirdly, flexibility refers to the "ability to adapt rapidly to events or issues … without significantly increasing operational costs".[73] In public procurement, flexibility is often sacrificed on the altar of compliance with the rules, and it is often difficult for public agencies to adapt to new situations without terminating a procurement process. Whilst the discretion of public servants is constrained to minimise the opportunities for corruption, blockchain provides the opportunity for real-time tracking of data and information, which can be used for contingency planning.

Finally, stakeholder management speaks to the provision of effective governance to enable communication, risk reduction and trust among the parties involved.[74] In public procurement, stakeholders include the parties involved in a procurement process, citizens, civil society and public-sector accountability mechanisms such as the Auditor-General. Managing these stakeholders and providing accurate, timely and relevant information is a problem that affects procurement systems across the world. Blockchain can improve stakeholder management, as transactions conducted on it are decentralised. An open blockchain will also afford the public access to extremely granular information on a procurement process. Mexico is currently testing a blockchain application for tracking public tenders and government contractors.[75]

A typical public procurement process in South Africa comprises several phases. These are the pre-procurement phase, which consists of project identification and design; the procurement and project delivery phase, which involves project execution, and the completion phase, during which project objectives are evaluated.[76]

The phase that is subject to the most regulation is the procurement and project delivery phase, which consists of advertising, evaluation, selection, contract award and contract implementation and management. The procurement phase usually commences with an advertisement in an appropriate medium to notify prospective bidders about the contract opportunity and advise them of the tender requirements. This process can easily be incorporated into a blockchain platform, where a procuring entity could create a request to purchase from the private sector, specifying criteria such as price, delivery date and functionality. Participating bidders on the platform are notified of the request and could submit bids, including details of any conditions they might wish to impose. The procuring entity could then choose either to automatically select a supplier, for instance the first supplier to meet the procuring entity's requirements, or to manually select a supplier, for instance by further competition between compliant suppliers. Clauses could be added to the smart contract to trigger specific events. For example, a delay in delivery could result in a penalty, which is automatically charged to the supplier.[77]

An important aspect of the procurement process is verifying the suitability of potential suppliers. In public procurement, this is undertaken by an extensive qualification process, which verifies bidders' compliance with legal regulations and determines their responsibility and ability to perform the contract. Relevant factors include past contractual performance, prior convictions, financial records and technical qualifications. A procurement blockchain platform can improve the process for identifying and verifying potential bidders,[78] simplify contractor registration, provide a shared information repository on contractors' past performance, and enable real-time reporting.[79] A government-wide procurement platform could thus be used to on-board contractors and ensure transparency on contractor relationships with all public-sector agencies.[80] This would reduce the risk of doing business with new contractors, open the door to increased competition[81] and participation in public tenders, whilst reducing the barriers to entry for smaller suppliers who do not currently participate in public tenders due to the high costs involved.[82]

A blockchain-based procurement contract is attractive for several reasons: The auditability and verifiability of transactions is unparalleled compared with paper

and e-procurement systems, which are prone to fraud and manipulation. The transaction record may also provide the data that could be used to uncover anti-competitive practices, which often go unnoticed in the procurement process, and the transparency inherent in the blockchain meets the highest standards for public-sector accountability.

VI. LEGAL CHALLENGES WITH REGULATING SMART CONTRACTS

Like most procurement lawyers, I am often concerned with whether the procurement regulatory framework is fit for purpose. Despite the shortcomings of extant procurement regulations, they serve to ensure consistency in public procurement and can fulfil policy objectives, if properly implemented. In his thesis, Udeh (my first LLD candidate), identified the goals of procurement regulation as being competition, integrity, transparency, efficiency, customer satisfaction, value for money, wealth distribution, risk avoidance, and uniformity.[83] Procurement regulation also provides the means for enforcing procurement rules and remedying breaches where they occur. We thus need to consider whether smart procurement contracts can be regulated in the same manner as traditional procurement contracts, and how to resolve smart procurement contract disputes.

Procurement in South Africa is regulated by several pieces of legislation as well as institutional oversight.[84] The laws provide direction on the procurement process, prohibited practices, and accountability and governance. In terms of institutional oversight, the National Treasury houses the Office of the Chief Procurement Officer (OCPO), which is broadly responsible for overseeing public procurement in the country.[85]

A public procurement blockchain platform has the potential to transform the fragmented nature of procurement oversight by providing the OCPO with access to real-time information and metadata on public procurement contracts across the country. The procurement blockchain can provide the OCPO with information on, for instance, transversal contracts,[86] and enable the OCPO to monitor those contracts whilst managing relationships with stakeholders and contractors. A blockchain platform will help us understand areas of conflict within the regulatory framework, enhance the efficiency of the OCPO's oversight, and reduce friction and disputes within the system.

Conducting public procurement via a blockchain platform ought not to change the nature of procurement regulation, but may serve to make procurement more efficient, transparent and less likely to result in disputes. This is partly because the terms of the contract and the state of facts relating to the performance of the contract cannot be amended or overridden by any individual, whether maliciously or mistakenly.[87] Blockchain ensures that there is always a single version of the truth.

An important function of procurement regulation is to provide for remedies in the event of a breach of the procurement rules. Disputes may be brought by different classes of persons affected by the procurement process, such as unsuccessful bidders, contractors and contracting authorities. In South Africa, complaints are commonly brought by aggrieved bidders, who have been referred to as "private Attorney Generals"[88] for ensuring compliance with procurement regulation.

There is a misconception that because they execute automatically, smart contracts wholly remove the potential for disputes.[89] In reality, however, whilst they reduce the scope for disputes, partly because of the reduced ambiguity in programming language,[90] the intersection of contract law and code creates new areas of potential dispute.[91] One issue that arises is how smart contracts can be terminated or modified for reasons such as performance on the basis of inaccurate data, discrepancies between the computer code and the natural language of the contract,[92] or rescinded for a vitiating circumstance. With a smart contract, the aggrieved party will essentially be seeking a remedy for a contract that has already been executed by the time the court hears the case.[93] Any remedy must come after the fact to undo or alter the agreement in some way,[94] as injunctions cannot operate to delay or stop performance once a dispute arises.

There have been a few suggestions as to how smart contract disputes may be resolved. These will either take the form of resolution in a traditional forum (whether courts or by arbitration) or online dispute resolution, which may be on the blockchain itself. Parties could incorporate a reference to arbitration into the smart contract, including information about the seat of arbitration and the governing law.[95]

In relation to online dispute resolution, "the parties may agree to refer disputes … to a central blockchain administrator with the power to determine disputes and insert remedial transactions into the blockchain as necessary".[96] A variation on this is where parties incorporate into the smart contract an agreement to refer disputes to arbitration, and a mechanism to

allow the arbitrator to automatically enforce any award without the intervention of a third party. For example, the multi-signature (or "multi-sig") mechanism "enables the parties collectively to nominate an arbitrator, which then triggers the power of that arbitrator to transfer assets or money on the blockchain".[97] Another approach that marries blockchain technology with traditional resolution is where disputes are referred to arbitrators, and their decision is then recorded on the blockchain.[98]

In the context of public procurement in South Africa, however, the court in *Airports Company South Africa Ltd v ISO Leisure OR Tambo (Pty) Ltd*[99] has made it clear that procurement disputes cannot be the subject of private arbitration. In this matter, it was held that "s 7(4) of PAJA precludes any forum, apart from the High Court and the Constitutional Court, to adjudicate over claims brought in terms of PAJA. The parties cannot … confer jurisdiction upon a private arbitrator to decide a claim brought in terms of PAJA. To allow such would be to allow parties to privatize constitutional disputes, and this bears the risk of allowing a parallel constitutional jurisprudence to develop in this country — one that is separate and independent from that developed by the Constitutional Court".[100]

This signals that private-sector dispute resolution models in their current form may not be utilised to address the *administrative law* aspects of smart procurement contract disputes, and that such contracts will need to contain embedded instructions for reference to the courts. This will severely test the courts' adaptability, but I have faith in the Constitutional Court, as it has already proven its creativity in addressing public procurement disputes.[101]

VII. CONCLUSION

This paper has presented the transparency and auditability of blockchain technology as a solution to the problem of corruption in public procurement. As the technology is still being piloted in various spheres, we might be some years away from its adoption, but I am convinced that, in the long term, as it continues to gain traction and prove its functionality, we will begin to see blockchain platforms increasingly being used by the public sector. Like most new ideas, the adoption of blockchain will have to overcome obstacles, which might include an aversion to new technologies, integration with legacy systems, the cost of adoption, and gaining stakeholder support. What will be crucial is whether we, as legal academics, will be able to understand and teach the legal implications of blockchain for the private law of contract, for taxation, and for the public procurement system.

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