



Unlocking Government Transparency with Blockchain Technology:

A Model for a Blockchain-Based Procurement Solution

Prepared For: Ashley Lannquist
Project Lead, Blockchain and Distributed Ledger Technology
World Economic Forum

Prepared By: Rachel Davidson Raycraft

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Acronyms

CSO: Civil Society Organization

GDP: Gross Domestic Product

IDB: Inter-American Development Bank

MAPS: Methodology for Assessing Procurement Systems

OECD: Organization for Economic Co-operation and Development

SIGMA: Support for Improvement in Governance and Management

UN: United Nations

UNCAC: United Nations Convention Against Corruption

UNICITRAL: United Nations Commission on International Trade Law

UNODC: United Nations Office on Drugs and Crime

WEF: World Economic Forum

WTO: World Trade Organization

WTO GPA: World Trade Organization's Government Procurement Agreement

Executive Summary

Worldwide, governments devote an estimated 10-30 percent of GDP—a total of approximately US\$9.5 trillion—to procurement contracts annually. However, this process is often marked by complexity, opacity, and a high degree of human discretion. This combination of factors—the enormous sums of money involved and the lack of transparency—results in a substantial risk for corruption. Despite the implementation of increasingly robust anti-corruption legal frameworks worldwide, the United Nations (UN) and the Organization for Economic Co-operation and Development (OECD) estimate that 10-30 percent of a public contract's overall value is commonly lost to corruption, diverted to the pockets of self-serving government officials, corporate executives, and other participants (OECD, 2016; UNODC, 2013).

To address the lack of transparency and accountability which pervades public procurement across the globe, the World Economic Forum (WEF) has partnered with the Colombian Inspector General's Office and the Inter-American Development Bank (IDB) to pilot a blockchain-based solution to procurement corruption. While the pilot is ongoing in Colombia, the solution is ideally intended for global deployment. Consequently, the analysis contained in this report is global in focus.

First, this report details the innumerable social, political, and economic harms caused by procurement corruption and describes the shortcomings of existing anti-corruption infrastructure. While impressive regulatory frameworks possessing minimum procurement standards and corruption-related legal sanctions are now commonplace at the national and local level worldwide, corrupt practices persist in force. Weak rule of law or limited political will for enforcement all too often stunt the corruption-reduction potential of such measures in practice. As a complement to the letter of the law, many countries have begun to experiment with electronic procurement (“e-procurement”), which transplants formerly paper-based and in-person transactions to the web with the goal of increasing transparency and efficiency. However static and underutilized webpages have done little to move the anti-corruption needle in the overwhelming majority of countries.

This report goes on to explain why blockchain-based procurement provides a promising next step toward greater accountability and transparency in public procurement. Blockchain is an open, distributed ledger technology that boasts a variety of unique qualities that speak directly to many of the persistent vulnerabilities of existing legal and e-procurement measures. Transactions which occur and data which is stored on a blockchain network are immutable, impartial, traceable, and secure. Most uniquely, these transactions and data are also entirely and immediately viewable by the general public—opening unprecedented opportunities for citizen monitoring.

However, blockchain's potential does not necessarily translate into anti-corruption success. Evaluating the progress of blockchain auctions and enacting complementary procurement policies may prove essential to maximizing the benefits and anti-corruption capacity of blockchain-based procurement. To this end, this report proposes an evaluation framework for blockchain-based procurement auctions based on five key performance indicators: (1) transparency, (2) accountability, (3) corruption prevention, (4) fairness, and (5) broader measures of performance. The report also outlines a menu of complementary policy proposals, all of which would help increase transparency, accountability, and citizen engagement throughout the procurement process.

Finally, the unique qualities that make blockchain a promising tool for reducing corruption in public procurement also lend themselves well to a variety of additional contexts. This report ends with a

description of emerging anti-corruption use-cases for blockchain technologies, related to land rights, elections, beneficial corporate ownership, and grant disbursements. As in the context of public procurement, there are pros, cons, and many unknowns to the adoption of blockchain in these realms of governance.

Overall, this report aims to support the WEF's development of a blockchain-based procurement solution with a hopeful yet realistic analysis of how blockchain can fill the current void in accountability and transparency in public procurement, and thus, reduce the harms of corruption worldwide.

Background

The Problem: Mass Corruption in Public Procurement

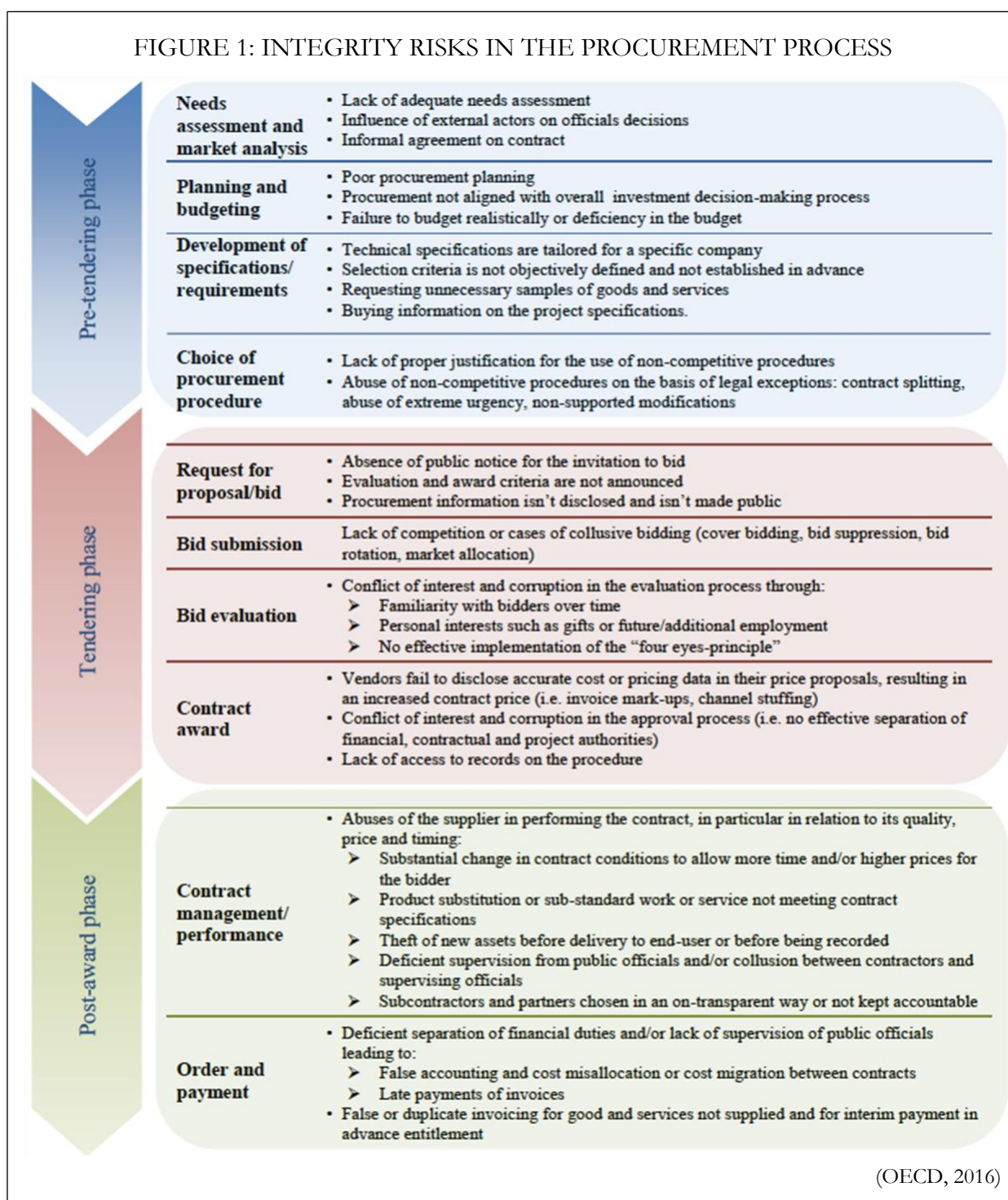
According to leading international organizations such as the OECD and Transparency International, public procurement, also referred to as government contracting or tendering, is one of the public sector activities most vulnerable to official corruption (OECD, 2016; Transparency International 2014).¹ Public procurement involves the acquisition of goods or services by a government or government-owned entity. Such contracts may be formed to build public infrastructure, supply military equipment, extract nationalized resources, provide telecommunications and electricity, or deliver social services, among many other purposes (World Bank, 2007).

In the case of large government contracts, public procurement usually consists of four phases—planning, bidding, bid-evaluation, and implementation and monitoring (Transparency International, 2014)—while smaller or highly complex contracts may be awarded via a direct or negotiated purchasing agreement (Martini, 2015; World Bank, 2007). Each phase of each kind of public procurement process presents its own challenges and opportunities for corruption, including bribery, undue influence on government needs assessments, private-sector collusion, bid-rigging, coercion, extortion, and fraudulent submissions and bid evaluations (OECD, 2016; Transparency International, 2014). The OECD found that procurement corruption accounts for more than half of the reported foreign bribery cases, with estimates averaging 20-30 percent of project value loss per contract due to corruption (OECD, 2016; Transparency International, 2014). For a more complete list of integrity risks in the public procurement process, see *Figure 1*.

Public procurement is a hotbed of corruption for various reasons: **1)** Vast sums of government money are offered to the private sector annually. Governments spend about US\$9.5 trillion per year on procurement (Center for Global Development, 2014), or an average of approximately 15 percent of national GDP worldwide (Djankov, 2016). **2)** Public procurement involves close and repeated interaction between government officials and profit-driven private sector actors. This opens the door to corrupt self-dealing by actors who seek personal gains through illicit payments or hope to secure repeat contracts through illegitimate means (World Bank, 2007). **3)** Beyond the private sector, public procurement involves and affects a wide variety of stakeholders (OECD, 2016). Given the massive role that these projects play in shaping society and generating jobs, government officials, civil society, citizens, and residents all possess significant motive to self-interestedly influence procurement decisions. **4)** The procurement process is complex and very bureaucratic, which increases the opportunities and motivation for shortcuts and “wheel-greasing” (OECD, 2016; World Bank, 2007). **5)** There is frequently little transparency in the needs assessment, contract specification, and vendor selection processes, which leaves the distribution of massive sums of money at the discretion of procurement officials (Kahn et al., 2018; World Bank, 2007). **6)** People rarely report corrupt activity in the public procurement process even when they become aware of it. This is often attributed to a sense of distance from, or indifference toward, government financial loss, the absence of effective reporting and whistleblower channels, or the feeling that complaining would be futile or result in reprisal (Transparency International, 2014).

¹ Throughout this paper, “official corruption” refers to the abuse of entrusted power for private gain (IMF, 2019).

FIGURE 1: INTEGRITY RISKS IN THE PROCUREMENT PROCESS



Certain auctioning processes and industry areas are particularly opaque and thus especially vulnerable to corrupt practices. For example, direct purchasing agreements and negotiated contracts are generally not awarded based on a set of predetermined, objective criteria, which make these award processes far more difficult to monitor or audit as compared with open bidding (Transparency International Georgia, 2013; World Bank, 2007). Similarly, the lack of easily obtainable market guideposts and the unpredictability of many major construction projects leaves needs assessments and post-award

adjustments largely to the discretion of government officials and their chosen private-sector counterparts (Wells, 2014).

The Harm: Crippling Public Services, Economic Development & Democracy

Corruption in public procurement results in a myriad of social and economic harms. First, bribe payments are frequently included in the price of the contract, thus inflating government spending and distorting market prices. Exacerbating this burden on governmental budgets, foreign investors often become reluctant to invest in countries with known corruption risks (OECD, 2016; Transparency International, 2014; World Bank, 2007). Additionally, by tampering with the vendor selection process, corruption reduces healthy competition and frequently results in the delivery of substandard goods, inefficient services, or non-fulfillment of the contractual terms (Dal Bó & Rossi, 2007; OECD, 2016; Transparency International, 2014; World Bank, 2007). Finally, corruption breeds distrust in public officials, who become viewed as profit-seeking and self-interested—an impression which often takes generations to overcome (OECD, 2016; Urizar & Torchiano, 2018; World Bank, 2007).

The ripple effect of procurement corruption is no less severe than its more immediate harms. Official corruption is a central challenge to democracy and economic development (Landell-Mills, 2013; World Bank, 2007). By eroding faith in elected officials, siphoning tax-payer dollars, and reducing the quality of government-funded projects and services, procurement corruption is far more than government money down the drain. In this vein, the World Bank asserts that, “the curtailing of procurement corruption may represent one of the most effective economic development programmes that a country can adopt” (World Bank, 2007, p. 7).

CASE: THE MANIFESTATIONS & IMPLICATIONS OF PROCUREMENT CORRUPTION IN COLOMBIA

A recent study by the country’s Corruption Ombudsman, in partnership with Transparency for Colombia and the Charles Leopold Mayer Foundation, found that approximately US\$6.01 billion dollars were compromised by procurement corruption in Colombia between 2016 and 2018. The sectors most affected by corruption included education, infrastructure and transportation, health, and civil services (El Tiempo, 2019). For example, in a 2017 investigation of the school meal program (PAE), which provides breakfast and lunch for the poorest children in Colombia, the country’s Comptroller General revealed disturbing irregularities in the pricing and delivery of the food, with contractors purchasing chicken breasts at four times the market price and 32 million meals going undelivered in 2016 (El Tiempo, 2017).

The Colombian government recognizes that public procurement is one of the weakest links in the country’s anti-corruption efforts at the national, regional, and local level (Gutiérrez, 2013). However, recent attempts at reform, including the 2011 Anti-Corruption Act and the new federal Anti-Corruption Office, have done little to reduce instances of corruption (Gutiérrez, 2013). In fact, in 2017, the U.S. Department of Justice indicted and ultimately extradited Colombia’s National Director of Anti-Corruption on bribery and money laundering charges (U.S. Department of Justice, 2018). Notably, Colombia’s experience with corruption is more or less average—ranking 96th amongst the 180 countries cataloged in Transparency International’s 2019 Corruption Perceptions Index (Transparency International, 2019).

Furthermore, even when procurement corruption is caught, the effects of accountability measures send shock waves through countries. Most recently, Latin America’s largest construction conglomerate, Grupo Odebrecht, declared bankruptcy after a 2014 investigation led by Brazilian, U.S., and Swiss officials found the company had paid US\$800 million in bribes to governments across the

region (Reuters, 2019). This high-profile investigation and the subsequent annulment, or potential annulment, of corrupt contracts paralyzed related industries across the region—interrupting payment chains, causing the bankruptcy of suppliers, and resulting in the dismissal of thousands of workers (de Michele, 2018; Trevisani et al., 2019). Furthermore, the company’s bankruptcy declaration leaves Brazilian state-owned banks with the majority of Odebrecht’s US\$25.3 billion debt, a financial blow which ultimately will fall on the shoulders of Brazilian taxpayers (Trevisani et al., 2019).

As a deterrent backed by legal force, steep financial consequences, and possible incarceration, the criminalization and prosecution of procurement corruption are essential components of any country’s anti-corruption framework. However, proactively limiting opportunities for corruption in the first place may more efficiently minimize the various financial, societal, and political harms, which emanate from this widespread phenomenon (Landell-Mills, 2013). To this end, the leading international institutions tasked with anti-corruption oversight universally advocate increased transparency and accountability throughout the public procurement process (Kahn et al., 2018; OECD, 2016; Transparency International, 2014; UNCAC, 2003; UNCITRAL, 2014; World Bank, 2007).

Existing Efforts to Curb Procurement Corruption

This section outlines the existing approaches to mitigating procurement corruption—laws, regulations, and electronic procurement systems (“e-procurement”). While these efforts have made inroads toward adequate procurement accountability and transparency, even best practices leave significant room for obscurity and discretionary self-dealing.

Legal & Regulatory Frameworks

Anti-corruption public procurement laws and regulations are now commonplace, with 180 countries included in the World Bank’s 2016 public procurement policy benchmarking report (World Bank, 2016). While such laws vary significantly country to country, best practices dictate a two-pronged regulatory strategy, addressing both minimum standards for effective procurement procedures and a variety of civil, criminal, and administrative sanctions for those who commit acts of procurement corruption (Gordon, 2013).

In the context of minimum standards, best practices are outlined in prominent international frameworks, such as the World Trade Organization’s Government Procurement Agreement (WTO GPA), the 2011 Model Procurement Law issued by UN Commission on International Trade Law (UNCITRAL), and Article 9 of the United Nations Convention Against Corruption (UNCAC), the latter of which boasts 186 state parties (Gordon, 2013; UNCAC, 2003).² The key provisions in these frameworks require that:

- Procurement laws and regulations be made publicly available;
- Potential bidders are given a reasonable amount of time to prepare and submit bids;
- Solicitation procedures and bid selection criteria are pre-established, objective, non-discriminatory, and published in advance of the procurement auction;
- Specifications in solicitations are not unduly restrictive; and

² Additionally, for the past twenty years, every free trade agreement the United States has signed includes government procurement provisions that contain the same core requirements as these international frameworks (Gordon, 2013).

- Governments ensure that bidders have access to a forum for protests—with countries increasingly requiring a protest-triggered “stay” period to allow for pre-award redress and to provide the opportunity for protestors to compete in an honest process (Gordon, 2013; UNCAC, 2003; UNCITRAL, 2014; WTO, 2014).

In addition to these core principles, the model laws acknowledge non-open bidding procurement processes (such as direct purchasing agreements) and allow for their use as needed, based on the urgency of the project, the pool of qualified bidders, and the size of the contract, amongst other considerations (UNCITRAL, 2014; WTO, 2014). The UNCAC also calls for various measures to regulate personnel responsible for procurement, including declarations of conflicts of interest, screening procedures, and training requirements (UNCAC, 2003).

On the sanctions side, best practices are embodied by the UNCAC and the OECD Anti-Bribery Convention³ (Martini, 2015; OECD, 2011; UNODC, 2013). The core principles require:

- The codification of criminal, administrative, and civil penalties for domestic and international bribery and corruption;
- State capacity to investigate and prosecute individuals and agencies found to have bribed a public official;
- Administrative sanctions for non-compliance, including disqualification from participation in future public procurement processes, judicial supervision, and judicial winding-up orders or compulsory liquidation;
- The termination of corrupt contracts;
- The confiscation of gains obtained through corrupt practices;
- Liability for damages to those financially harmed by the corrupt practices; and
- Prohibitions against whistleblower reprisal (Martini, 2015; OECD, 2011; UNDOC, 2013).⁴

The OECD Anti-Bribery Convention also contains a variety of recommendations, such as adequate accounting and financial reporting, corporate internal compliance mechanisms, and mandatory external audits (OECD, 2011).

While the adoption of such measures is an important step toward curbing procurement corruption, on-the-ground realities frequently limit the impact of such efforts no matter how good they may sound on paper (Sandgren, 2005). Weak rule of law or limited political will for enforcement combined with the significant discretion generally enjoyed by procurement officials all too often stunt the corruption reduction capacity of such laws in practice (Gordon, 2013; Landell-Mills, 2013; Martini, 2015).

Additionally, the codification of laws itself can reduce the transparency and efficiency of the procurement process, as countries tend to overregulate (or “micro-regulate”) and under-publish the

³ Notably, while the OECD Anti-Bribery Convention only dictates the laws of its 44 state parties, its impact is far reaching due to the financial and political reach of OECD countries and the extraterritorial application of some of its core principles—namely, those which criminalize the bribery of foreign public officials in international business transactions. These provisions, based on the Foreign Corrupt Practices Act, first enacted in the United States in 1977, make it a criminal violation for a company (for example, one based in the United States) to bribe a foreign official (for example, a political official in Germany), in furtherance of business interests (for example, to obtain a procurement contract) (U.S. Department of Justice & U.S. Securities and Exchange Commission, 2012).

⁴ Similar regulatory frameworks have also been adopted by regional and industry-specific bodies, such as the Extractive Industries Transparency Initiative, the Inter-American Convention Against Corruption, and the European Convention against Corruption Involving Officials, amongst others.

legal framework (World Bank, 2007, 2016). On the vendor side, micro-regulation heightens the motivations and opportunities for corruption by increasing the frequency of public-private interaction throughout the procurement process. On the government side, micro-regulation frequently breaks down the responsibilities of procurement officials into discrete, mundane tasks that reduce the need to hire qualified employees and erode any sense of accountability for the overall outcome (World Bank, 2007).

Finally, anti-corruption investigations and enforcement mechanisms depend substantially on data that does not exist—due to incomplete reporting or cost of collection—and on public collaboration that governments frequently cannot inspire (World Bank, 2007).

A study by the OECD found that “the impact of new rules on the challenge of corruption has regularly been overestimated. Judicial tools are insufficient unless the risk for those involved in corruption is increased” (World Bank, 2007, p. 15). Consequently, as a complement to anti-corruption laws and policies, countries around the world have begun to adopt electronic procurement technologies in an effort to more effectively enforce the existing regulatory structure and to proactively minimize the opportunities for procurement corruption.

E-Procurement Programs

Electronic procurement (“e-procurement”) refers to “the use of any internet-based inter-organizational information system that automates and integrates any part of the procurement process in order to improve efficiency, transparency, and accountability in the wider public sector” (Basel Institute on Governance, 2015, p. 67). By transferring the formerly centralized and opaque processes of public procurement to the internet, e-procurement promotes transparent and efficient information flows and increases accessibility for prospective vendors and civil society (EBRD, 2015). Any or all of the procurement process can occur on an electronic platform—advertising, tendering, bidding, awarding, purchasing, ordering, contracting, invoicing, and other forms of project management (EBRD, 2015). The WTO GPA and UNCITRAL Model Law both address the utility of online procurement systems, recommending certain parameters and minimum standards including:

- A widely accessible platform—both in terms of interoperability, cost, and the universe of stakeholders;
- Adequate authentication, encryption, and security; and
- Clear governance—essentially mirroring best practices in non-electronic public procurement (UNCITRAL, 2014; WTO, 2014).

Additionally, initiatives like the Open Contracting Partnership (OCP) and the Open Data Charter have developed e-procurement-specific best practices and core principles. These frameworks are endorsed by both the public and private sectors and have been adopted by dozens of national and local governments (OCP, n.d.; ODC, n.d.). Both initiatives aim to leverage the growing prevalence of electronic procurement data toward greater information dissemination, transparency, and citizen monitoring.

A vast majority of economies across the world have adopted e-procurement systems as a national policy (World Bank, 2016). The services offered on these platforms range from static informational hubs to interactive portals where vendors and procurement officials can carry out the entire tendering process (World Bank, 2016). Overwhelmingly, studies have found that these systems promote the anti-corruption agenda in numerous ways. E-procurement tends to increase transparency and

accountability by reducing information asymmetries, facilitating stakeholder oversight, preserving a catalogue of transactions and past contracts, minimizing human interaction, and limiting official discretion through automation and publication (ERBD, 2015; OECD, 2016; Transparency International, 2014; World Bank, 2007, 2016). Additionally, e-procurement systems have produced benefits beyond the anti-corruption agenda, with studies showing increased vendor competitions and government savings⁶ (ERBD, 2015; OECD, 2016; Transparency International, 2014; World Bank, 2007, 2016).

However, many of these studies focus on the yet-to-be-realized potential of the technologies or best-case scenarios.⁷ The attainment of these benefits depends on the nature of the e-procurement services and the surrounding policy infrastructure. Though at least 154 countries use some form of national e-procurement system, most merely publish public procurement laws and regulations, with far fewer countries publicizing procurement plans (74 countries), tender documents (97 countries), and award notices (122 countries) (World Bank, 2016). Even fewer countries legally mandate such measures (World Bank, 2016).⁸ Additionally, digitizing core interactive aspects of the procurement process, such as electronic submission of bids and bid-opening,⁹ remains the exception, with OECD high-income countries at the forefront of these initiatives (World Bank, 2016). Of the economies which do accommodate electronic bid-opening, only two—Kazakhstan and Malta—systematically produce information on this process to bidders (World Bank, 2016). Furthermore, e-procurement data and documentation are often restricted to government officials and registered vendors, thus largely perpetuating information asymmetries and opacity vis-à-vis civil society and the public at large (Transparencia, Mexicana, 2012).

E-procurement implementation can also be stunted by technological, social, and legal barriers. Low levels of internet penetration, inadequate end-user training, and deficient data security may limit the participation of vendors and civil society (Azanlerigu & Akay, 2015; Nawi et al., 2017; Ujakpa et al., 2016). Existing laws can also hinder the adoption of e-procurement by mandating hard-copy procurement documentation or inadequately addressing e-procurement concerns, like the force of e-contracts and the role of electronic signatures (Azanlerigu & Akay, 2015; Nawi et al., 2017). However, such barriers to implementation vary greatly based on the country and industry context.

Despite these hurdles, e-procurement presents a promising path forward. If informational asymmetries and opaque processes are primary impediments to the effective enforcement of otherwise robust anti-corruption legal and regulatory frameworks (Sandgren, 2005), the information

⁵ For example, within a year of launching its e-procurement platform, tenders in Georgia rose from 1,923 to 33,000 (World Bank, 2016).

⁶ Outside of corruption prevention-related savings, e-procurement can substantially reduce transaction costs for bidders throughout the procurement process by eliminating document preparation, printing, and transportation costs. Countries report efficiency gains of 10-20 percent of the total volume procured via electronic means (World Bank, 2016). For example, through the implementation of an e-procurement system, the Chilean government increased savings from US\$180 billion to US\$280 billion from 2010 to 2012. Similarly, the use of e-procurement allowed the Portuguese government to save US\$206 million within the first two years of operation (World Bank, 2016).

⁷ Some of the best e-procurement programs, in terms of comprehensiveness and impact, include KONEPS in Korea (Public Procurement Service, n.d.) and Prozorro in Ukraine (Granickas, 2018).

⁸ For example, only 24 countries mandate the publication of procurement plans (World Bank, 2016).

⁹ “Bid-opening” refers to the phase of the procurement process in which bids are unsealed and reviewed by government officials. Each bid is read aloud and reviewed for completion and project qualifications. Vendors often can attend a bid-opening if they so choose, though it is not required (Calamaras, n.d.).

proliferation and stakeholder engagement capacities of e-procurement speak directly to these concerns.

Blockchain-based Procurement: Enhancing Transparency and Accountability through Open-Ledger Technologies

The next generation of e-procurement, blockchain, is an open, distributed ledger technology that records transactions in a verifiable and permanent way. Blockchain allows anyone with internet connection to use an electronic platform to transfer anything of value—money, data, documentation, etc.—with “unmatched security and integrity” (Shang & Price, 2018, p. 74). Through transparent “ledgers” which document all sides of each transaction, blockchain complements its structural security and integrity with unparalleled transparency, allowing third parties to view immutable records of each and every transaction. Officially invented in 2008, blockchain has transformed from a vehicle for the exchange of electronic or “crypto” currency, to a technology that could revolutionize almost every industry and many government functions (Dughi, 2018).

Blockchain’s Anti-Corruption Qualities

A blockchain-based procurement solution may address many persistent shortcomings in procurement transparency and accountability, as well as existing deficiencies in e-procurement more specifically, such as incomplete information, inaccessibility, and lack of technological sophistication (Kahn et al., 2018). To this end, blockchain uniquely offers the following qualities:

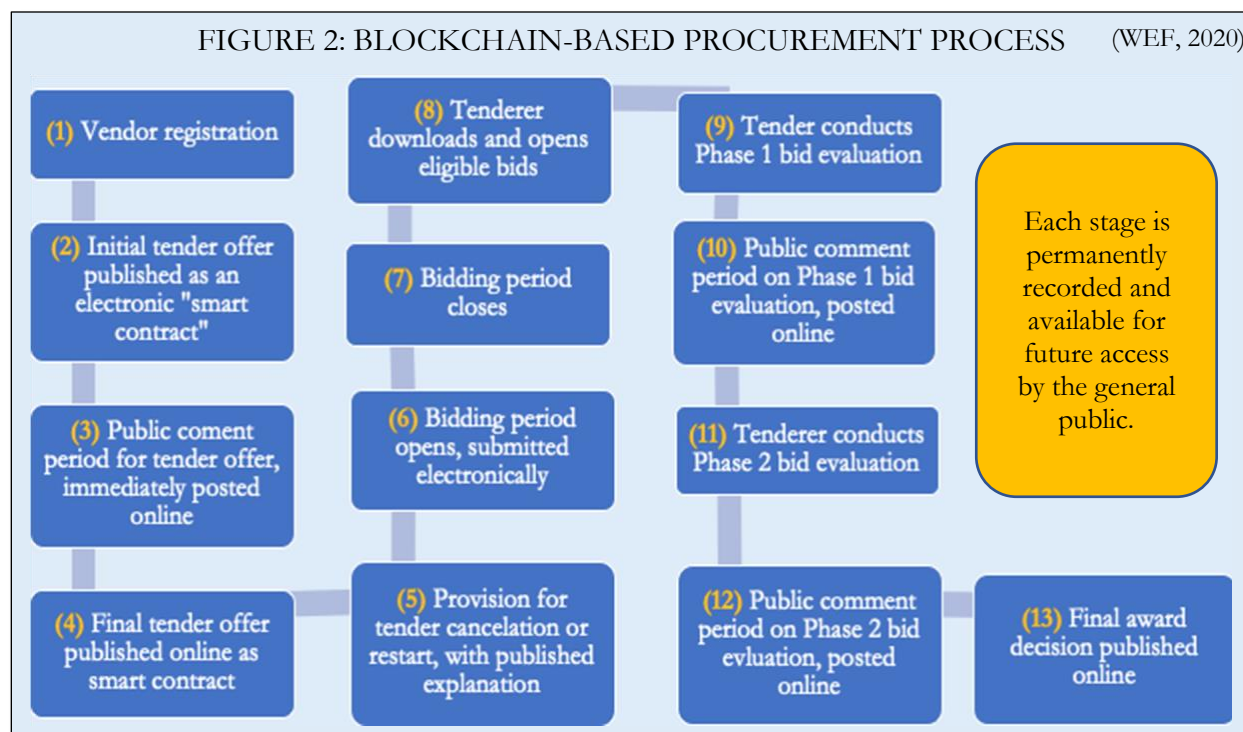
- **Transactional:** Blockchain is an inherently transactional platform. Each “block” represents a single transaction between parties, which is then added to the transaction history (“the chain”) to create a permanent record of the interactions between parties (Dughi, 2018). Given the transactional nature of the vendor-tenderer dynamic in procurement, blockchain is particularly well-suited for the procurement context. Furthermore, procurement transactions (i.e. bid submissions, price negotiations, or contractual exchanges) have proven amongst the most challenging aspects of the procurement process for e-procurement platforms to capture.
- **Immutable:** Every transaction on a blockchain platform is linked, which creates a complete and tamper-proof transactional record—all revisions or deletions are clearly and transparently documented on the ledger (Maltaverne, 2017). In the procurement context, this permanency and protection would facilitate subsequent audits or investigations and help mitigate societal and institutional concerns regarding the security of e-procurement transactions.
- **Impartial:** Every transaction is peer-to-peer, or, in the procurement context, vendor (company) to tenderer (government) (Maltaverne, 2017). The decentralized nature of blockchain addresses both information asymmetry and discretion concerns. No central authority would have the power to self-interestedly manipulate rules or selectively publicize information on the blockchain platform—“it does not matter if a large government or a local paramilitary organization disagrees with what it carries” (Piracés, 2018, p. 301). In this way, blockchain responds directly to concerns about the corruption risk of consolidated power and discretion in the hands of the few (Graglia & Mellon, 2018).
- **Transparent:** Every transaction on a blockchain platform is immediately publicly accessible and verifiable (Dughi, 2018; Hardwick et al., 2018). Users possess pseudonym addresses and personalized access keys, which ensure each transaction is perfectly traceable (Wachsman,

2019). “Every agreement, every process, every task, and every payment would have a digital record and signature that could be identified, validated, stored and shared” (Iansiti & Lakhani, 2017). Third parties are able to use this digital record to verify the validity and integrity of each and every transaction on the blockchain platform. This level of transparency offers unprecedented opportunities for information dissemination, auditability, and public participation—uniquely leveraging legal, financial, and social incentives against corrupt behavior (Graglia & Mellon, 2018).

- **Secure:** Blockchain offers a variety of security measures above and beyond standard internet-based e-procurement systems. First, every user is provided a unique key for blockchain access consisting of a passcode or biometric key. Every transaction performed by each user is tied to that user’s key, which functions like a digital signature. If a third party attempts to alter information contained on the blockchain, it will invalidate the digital signature and immediately notify the network (Li et al., 2018; Miles, 2017). Furthermore, the absence of a central authority or data hub means that there is no “single point of failure”—no single computer, if hacked, would make the network vulnerable to manipulation. Rather, over 51 percent of all computers in a network would have to be hacked and altered simultaneously for transactions to be manipulated. As blockchain networks grow in size, their vulnerability to hackers becomes increasingly impossible (Li et al., 2018; Miles, 2017).

Blockchain-based Procurement in Practice

Based on an ongoing partnership with the Colombian Inspector General’s office, the WEF has developed a “permissionless” or fully public blockchain-based procurement platform. The proposed system could be used for transactional, observational, and investigatory purposes by vendors, tenderers, auditors, and the general public. *Figure 2* depicts the WEF’s pilot blockchain-based procurement process, which builds upon existing Colombian procedures:



Blockchain's aforementioned qualities allow blockchain-based procurement to reduce current corruption vulnerabilities in public procurement by entrenching transparency, accountability, and integrity throughout the process. Some of the features of the WEF's proposed platform which specifically speak to these goals include the following: First, there are three public comment periods, which would allow third parties to anonymously submit feedback that must be incorporated into the next stage of the procurement process (Stage 3, 10, 12). Second, certain procedural irregularities will trigger red flags which notify the entire network. For example, if the tender is altered too close to the end of the public comment period, effectively preventing the public from holding the government accountable for said changes, or if contract award does not align with the government's predetermined criteria. Third, while the tender can be permanently withdrawn up until the bidding process opens (Stage 5), the tenderer would have to provide a published explanation as to why the tender was restarted or cancelled. Fourth, during the bid submission phase, vendors submit encrypted bids under their pseudonym addresses, which are later decrypted for the tenderer and the public once the tenderer downloads the bids (Stage 8). These measures promote anonymity prior to bid publication and enhance accountability post-bid publication. The tenderer then evaluates all bids against a predetermined set of objective criteria and selects those which are eligible for the next phase of the procurement process (Stage 9, 11). These assessments are made publicly accessible. Once public comments are incorporated into the bid selection process, the winning bid is ultimately selected and made public (Stage 13) (WEF, 2020).

Whereas incomplete public disclosure, unchecked discretion, and centralized or nonexistent records presently characterize many procurement processes, blockchain-based procurement offers comprehensive and timely public disclosure, published evaluation criteria and rationale, and immutable and accessible records for subsequent verification and investigation where necessary. A blockchain-based procurement solution could thus help fill some of the challenges that legal measures alone seem unable to promote—essentially disinfecting (or de-corrupting) through technologically induced sunlight.

At least three government institutions have launched blockchain-based public procurement systems in 2019. One at the U.S. Department of Health and Human Services is focused on project cost analysis and another, in Seoul, South Korea, is focused on proposal evaluation (Ledger Insights, 2019). A third, launched in the autonomous region of Aragon, Spain is focused on public procurement vendor selection and is the most similar to the WEF's Colombia pilot project (Gobierno de Aragon, n.d.). To date, all of the projects are said to be functioning effectively (Ledger Insights, 2019; WEF, 2020).

Implementation Challenges

While blockchain promises numerous improvements to status quo public procurement practices, it nonetheless should be embraced with caution. First and foremost, the potential benefits and harms of blockchain are still emerging. Governments have only recently implemented or piloted blockchain-based services (in procurement or otherwise) and time has yet to reveal the success or failures of these initiatives. The widespread excitement around blockchain solutions should not blind governments to the potential detriment caused by hasty or inadequately informed implementation.

Nonetheless, government buy-in is essential to the success of blockchain-based procurement. The WEF is currently working hand-in-hand with the Colombian government to develop a blockchain-

based platform that maximizes efficiency, integrity, and seamless integration into the existing legal and procedural framework. Notably, Colombian President Iván Duque has been vocally in support of incorporating blockchain technologies into the Colombian governance structure (Di Matteo, 2019; Patino & Arango M., 2019). Political enthusiasm around anti-corruption measures, such as blockchain-based procurement, partially stems from the recent wave of corruption scandals that rocked the region in 2015 and 2016. However, the momentum for reform is now beginning to fade (Londoño & Casado, 2019). Without genuine and full governmental cooperation, the WEF's project would be largely futile as the government ultimately dictates procurement platforms and methods.

Relatedly, the deployment of blockchain-based technologies alone will not reduce procurement corruption. Governments must also commit to using the platform effectively and implementing necessary complementary legal or regulatory measures (as described in further detail below). In a country like Colombia, which largely already possesses gold standard anti-corruption procurement laws, policy adjustments may be comparatively marginal. However, in countries which have yet to embrace internationally recommended anti-corruption measures, the effective implementation of corruption-mitigating blockchain-based procurement will require more legal and procedural upheaval. Furthermore, the present lack of understanding of blockchain technology poses a significant barrier to the drafting of appropriate legal measures—be they marginal or monumental. Emerging blockchain-oriented regulation frequently misunderstands or mischaracterizes the technology, which may stunt its potential or trigger unintended consequences (Graglia & Mellon, 2018).

In addition to political buy-in, blockchain's ability to mitigate corruption risk depends on the willingness of the general public to engage with the platform. The technology's ability to disseminate timely and accurate information and its capacity to invite and empower citizen auditors may be its most substantial and unprecedented contributions toward corruption reduction. These features, in particular, shed light on a process that has historically been opaque and incredibly centralized. While it is in the public's self-interest to reduce procurement corruption, if citizen engagement is limited due to low internet proliferation, informational inaccessibility, lack of bandwidth, or disinterest, blockchain's anti-corruption potential may go largely unrealized. The below policy recommendations should assist with this hurdle by systematically engaging and legally empowering citizen auditors, but auditor retention remains a concern. Nonetheless, the mere threat of external auditing may itself reduce corrupt practices (Avis et al., 2018).

There are also a number of challenges presented by the radical transparency of blockchain technology. Though blockchain shields user identity through the use of pseudonym addresses, the unprecedented traceability of each transaction allows for the possibility that vendor identity is prematurely or unintentionally revealed. Similar concerns apply to third-party users who may fear reprisal if corruption-related complaints can be traced back to them personally. Such security threats would require sophisticated hackers, but nonetheless remain relevant. The third-party comment function also raises some red flags. This system opens the opportunity for spamming and unfounded complaints, which may permanently remain on the blockchain platform. If such issues arise, governments will have to determine how best to balance transparency goals against the integrity and efficiency of the procurement process.

Finally, public large-scale blockchain platforms have scarcely been tested to-date. No existing public blockchain platform can support simultaneous use by millions of users—it has proven to be too expensive and energy-intensive to run such a system (Graglia & Mellon, 2018). However, if the decision to use a public platform proves unstable or unsustainable, public-private hybrid platforms

could make blockchain-based procurement viable. Such platforms use multiple portals (or websites) and empower each portal's users with distinct participation capacities. For example, the WEF could create three separate portals—one for tenderers, one for vendors, and one for third parties. Tenderers and vendors would register with a password-protected portal that allows them to actively use the blockchain platform to submit documents and interact throughout the procurement process. Third party portal users, on the other hand, would be limited to a more passive role of monitoring and publicly critiquing all blockchain-based activities. Notably, in this form, using a password-based hybrid platform in place of a permissionless public platform may not materially diminish blockchain's anti-corruption capacity.

While the novelty of blockchain potentially presents various technical hurdles and unknown policy challenges, some of the existing implementation concerns may dissipate as the technology evolves and greater understanding permeates society.

Evaluating a Blockchain-Based Public Procurement Platform

The initial implementation of an emerging technology inevitably involves trial and error. Soliciting and incorporating stakeholder feedback will allow the WEF and its partners to best translate this program into a user-friendly avenue toward concrete anti-corruption reform. This section proposes a framework of key performance indicators (KPIs) for evaluating the proposed blockchain-based procurement platform and outlines a general approach to data gathering. A proposed program evaluation survey can also be found in *Appendix A*.

Key Performance Indicators (KPIs)

The blockchain-based public procurement platform has two independently important objectives: It must (1) reduce instances of corruption throughout the public procurement process and (2) serve as an efficacious mechanism for public procurement. While distinct, anti-corruption and effectiveness are very much interrelated (USAID, 2005). The lack of transparency and accountability characteristic of the procurement process erode both of these objectives—greater opportunity for corruption leads to greater siphoning of government funds and greater contracting of unqualified or uninvested vendors. However, because anti-corruption initiatives may themselves lead to inefficiencies, it is nonetheless important that WEF captures both objectives in its evaluation metrics.

The intentional secrecy of corruption poses a significant barrier to the assessment of anti-corruption programs (Transparency International, 2019a). To meet this challenge, various leading international institutions and initiatives—including USAID,¹⁰ the World Bank,¹¹ the OECD,¹² Support for Improvements in Governance and Management (SIGMA),¹³ and the Methodology for Assessing

¹⁰ USAID's evaluation method focuses on (1) transparency, (2) accountability, (3) prevention, (4) enforcement, and (5) education ("TAPEE") (USAID, 2005).

¹¹ The World Bank measures performance in government procurement by assessing (1) cost-efficiency, (2) timeliness, (3) transparency, (4) quality, and (5) fairness (World Bank, 2015).

¹² The OECD public procurement performance indicators include (1) efficiency of procurement process; (2) openness and transparency of the procurement process; (2) professionalism of the procurement workforce; and (3) contract management and supplier performance (OECD, 2017).

¹³ SIGMA is a joint initiative of the OECD and the European Union, which aims to support socio-economic development through improve public governance. SIGMA's evaluation focuses on the nature of the data as opposed to the substance, categorizing them into (1) input indicators, (2) output indicators, (3) process indicators, (4) outcome indicators, and (5) quantitative indicators (SIGMA, 2016).

Procurement Systems (MAPS)¹⁴—have developed a variety of proxy indicators that speak to the presence or absence of corruption in government programs. The difficulty in pinpointing corruption has also led these institutions to advocate the triangulation of data from a variety of sources and perspectives, in order to corroborate the findings (Manandhar, 2014; Transparency International, 2019a; USAID, 2005). The below KPIs are also informed by metrics used in more specific evaluations of e-procurement programs in countries such as Bulgaria, Macedonia, Portugal, and Turkey (World Bank, 2015).

The proposed evaluation is designed to measure the results and experience of a single procurement auction. The KPIs are well-defined and verifiable, drawing on both qualitative and quantitative observations. While valuable on their own, the data are most informative when compared against baseline measures of past procurement auctions in identical or similar industry and country contexts (SIGMA, 2016). Such comparisons will allow for both objective and relative assessments of the blockchain solution.

KEY PERFORMANCE INDICATORS		
Performance Category	Definition	Key Performance Indicators
Transparency	The ability for citizens, businesses, public officials, and civil society to obtain material information about the procurement auction cycle. This includes both substantive and procedural transparency.	<ul style="list-style-type: none"> • Relevance and quality of published information • Timeliness of information published • Quantity of information published • Ease of search functions and overall platform usability
Accountability	The ability for citizens, businesses, civil society, and other stakeholders to check, balance, and oversee the procurement process. This includes both horizontal (internal/ governmental) and vertical (non-governmental) accountability.	<ul style="list-style-type: none"> • Platform accessibility • Amount of third-party traffic • Number of end-user comments submitted
Corruption Prevention	The reduction in opportunities for corruption. This includes factors which minimize monopolized and discretionary decision-making.	<ul style="list-style-type: none"> • Number of public-private in-person interactions • Openness of procurement process
Fairness	A procurement process based on vendor qualifications, merit, and honest competition.	<ul style="list-style-type: none"> • Number of vendors involved • Number of bids submitted • Value of winning bid

¹⁴ MAPS is the product of a multi-stakeholder initiative between international lending institutions, national development agencies, and nation states. It is the only tool that comprehensively assesses public procurement systems. However, for the purposes of this evaluation, the most relevant aspect of the MAPS model is Pillar IV: Accountability, Integrity and Transparency of the Public Procurement System, which assesses (1) transparency and civil society engagement, (2) audit systems, (3) procurement appeal mechanisms, and (4) ethics and anti-corruption measures (MAPS, 2018).

Broader Measures of Performance	The effectiveness and efficiency of the blockchain procurement platform more generally.	<ul style="list-style-type: none"> • Duration of procurement process • Cost savings • Platform security • Satisfaction with technical infrastructure and process • Regulatory barriers • Ease of training and usage
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Data Gathering

The proposed program evaluation triangulates data on inputs and outputs of the procurement process with user experiences conveyed through surveys of key stakeholders, including tenderers, vendors, government audit or anti-corruption agencies, and civil society.

Input indicators tend to be more subjective and less quantifiable than output indicators (SIGMA, 2016). The former refer to factors which facilitate the generation of desired procurement and anti-corruption outcomes, such as platform accessibility, the number of technological glitches, and the openness of the vendor-selection process. The latter refer to procurement and anti-corruption outcomes, such as the value of the winning bid and the quantity, quality, and timeliness of procurement information published.

While most of this data will be based on observable processes and outcomes, certain factors which are less externally verifiable, such as platform accessibility and user satisfaction, may involve end-user surveys. To allow for greater comparability, stakeholder surveys should be indexed (Manandhar, 2014; USAID, 2005). Respondents would describe their level of satisfaction on a scale from one to five, where a response of one indicates a total lack of satisfaction and a response of five indicates extreme satisfaction. However, some questions might require supplemental information from respondents. For example, knowing details on the specific regulatory barriers, if any, would be essential to crafting future procurement platforms or policy reforms. *Appendix A* provides a possible rubric of survey questions.

Data Limitations

There are a number of limitations to data gathered in the procurement corruption context. First, the findings may not be easily translatable. For example, if the WEF were to successfully pilot a blockchain-based solution for school meal procurement in Colombia, the very same technical and policy infrastructure may prove less effective for Colombian military contracts or South African school meal procurement. Anti-corruption procurement programs are never a one-size-fits-all solution—level of government, cultural norms, economic environment, industry, legal framework, and contractual particularities may alter the efficacy of any given anti-corruption program.

Second, there are two broad opportunities for corruption in procurement—the procurement award process and the execution of the procurement contract. The blockchain solution and the proposed evaluation only pertain to the former. However, given the close connection between effective vendor selection and successful contract execution, the WEF could consider a follow-up evaluation that

captures the latter, with indicators such as fulfillment of contractual obligations or market-based purchasing.

Finally, much of blockchain's anti-corruption potential lies in its ability to provide timely and comprehensive information to third party actors—citizens, civil society organizations, and oversight institutions, amongst others. However, stakeholder engagement is not immediate nor automatic and may not be fully leveraged at the time of blockchain deployment. Nonetheless, the initial program evaluation results should provide useful information on the need for, and nature of, future stakeholder engagement strategies.

Complementary Policy Proposals: Maximizing the Anti-Corruption Potential of Blockchain-Based Procurement

Blockchain's inherent ability to shine light on transactions through open and instantaneous information dissemination might in and of itself constitute a concrete step toward greater transparency in the procurement process. However, the full anti-corruption potential of blockchain-based procurement cannot be realized in the absence of a clear legal framework based on international best practices and effective stakeholder engagement and oversight.

As a baseline consideration, no policy recommendation will bear fruit in the absence of honest law enforcement, a functioning justice system, real consequences for violators, and political buy-in. Political resistance toward addressing official corruption may be lessening as high profile corruption scandals increase public attention toward, and transnational prosecution of, public corruption. Additionally, though efficiency considerations have historically posed a powerful counterargument to potentially onerous and time-consuming anti-corruption measures, blockchain speaks to both goals simultaneously. It cuts costs and time while seamlessly injecting procedural and substantive transparency throughout the procurement process.

While the particularities of each country and industry context make detailed policy proposals impossible, this paper highlights a number of policy solutions that would complement and magnify the anti-corruption capacity of blockchain-based procurement. To the extent that these policy proposals reflect best practices advocated by the OCP, the Open Data Charter, the OECD, the UN, and the WTO, they are not meant to create a superior or more urgent subset of recommendations. These international frameworks generally represent the gold standard of procurement law and should be embraced in their entirety at the national and local levels for maximum effectiveness. Rather, the selected policy recommendations below are meant to flag concrete initiatives that would specifically capitalize on the information dissemination capacity of blockchain-based procurement to increase accountability, transparency, corruption prevention, and fairness throughout the procurement process. For a more extensive list of anti-corruption procurement principles and practices advocated by leading international frameworks, see *Appendix B*.

Build a Comprehensive E-Procurement Hub

The value-add of a blockchain-based procurement platform is defined by the number of users and the nature of its use. In order to effectively leverage blockchain-based procurement toward corruption reduction, the following measures are recommended:

- 1) **Remove Legal Barriers:** Governments should revise laws that effectively limit the use of the blockchain platform, such as those which require in-person interactions between tenderer and vendor or mandate paper bid submissions.
- 2) **Mandate Use of the Designated Hub:** Governments should mandate the use of the blockchain platform to compel behavioral change away from in-person procurement processes and to consolidate all transactions on a single database (OECD, 2016; Luijken & Martini, 2014). However, particularly during the initial implementation of the blockchain platform, vendors should not be barred from procurement participation due to unpreventable technical roadblocks. Governments should provide an alternative avenue for participation, in accord with the established auction timeline, while the technical problems are being resolved. Upon resolution, all relevant documentation should be published on the e-procurement hub for public review. Governments should also enumerate clear criteria as to types of problems that would trigger this alternative avenue for participation, ensuring they are exceptional.
- 3) **Make the Hub Comprehensive:** Either the blockchain platform itself or an affiliated website should contain all relevant information about the procurement process, including procurement policies, procurement officer codes of conduct and special interest disclosure requirements, notices about upcoming auctions, tender documents, vendor bids, award and rejection criteria, award notices, contract details, and vendor blacklists¹⁵ and whitelists¹⁶ (Martini, 2015; Transparencia Mexicana, 2012). In addition to the initial procurement auction, all post-award contract renegotiations should be documented on the blockchain platform. As a hotspot for secretive self-dealing, contract renegotiation should be kept to an absolute minimum. When nonetheless necessary, requiring the renegotiation process to occur over the blockchain platform sheds light on adjustments to the initial agreement and eliminates incentive to renegotiate for corrupt purposes (Dinero, 2019; Transparencia Mexicana, 2012).
- 4) **Make Information Accessible:** All of this information should be freely and easily accessible to the public—structurally and cognitively. There should not exist exclusionary access fees or registration walls and the site content should be both searchable and downloadable (Luijken & Martini, 2014). Existing e-procurement websites like Open Public Contracts in Slovakia (<https://tender.sme.sk/en/>) and Tender Monitor in Georgia (<http://tendermonitor.ge/en>) provide a blueprint for such a platform. Both websites, developed by the national chapters of Transparency International, exemplify the power of concentrated and publicly available procurement data by enabling users to search for key signs of corruption, such as repeat bid winners, auctions with only one bidder, and relevant procurement contract details (Hunter & Chanturia, 2014; Transparencia Mexicana, 2012). While the general public may not regularly log-on to such a resource, the accessibility of good data propels citizen monitoring activities (Transparencia Mexicana, 2012).

Governments may also derive other benefits from increasing the accessibility of procurement information. Experience shows that easily accessible information allows for greater competition

¹⁵ In the procurement context, blacklists are used to sanction vendors recently found to have acted corruptly. States should enumerate the necessary internal reforms that would allow a vendor to be removed from a blacklist.

¹⁶ In the procurement context, whitelists are used to promote the participation of vendors who conduct business with integrity. Such lists can also be used to incentivize participation in non-compulsory anti-corruption measures, such as the Integrity Packs discussed below (Basel Institute on Governance, 2015).

amongst a wider variety of vendors, whereas short-term auction notice and opaque processes cater to the interests of large well-connected companies and repeat players (Bohem & Olaya, 2006; Luijken & Martini, 2014; World Bank, 2016). Beyond equity and opportunity considerations, this increase in competition overwhelmingly translates into significant cost savings and improved deliverables (Open Government Partnership, 2019).

Establish Competitive Auctions as the Default Procurement Process

In addition to the close correlation between increased transparency and increased competition, e-procurement platforms, like blockchain, can facilitate vendor participation by lowering the costs and physical barriers to entry (World Bank, 2016). While the extent of internet proliferation may pose a challenge in certain environments, electronic bid submission allows for greater participation amongst small and medium enterprises (SMEs) and non-urban entities that no longer have to bear the costs of paper applications and in-person meetings (OECD, 2016). States should reinforce and promote these competition-promoting qualities of blockchain-based procurement auctions by institutionalizing open auctions as the clear default procurement process.

- 1) **Remove Arbitrary Restrictions on Contract Eligibility:** As a base consideration, governments should minimize arbitrary or unnecessary restrictions on contract eligibility. This includes existing prohibitions against foreign or out-of-state companies and overly restrictive contract specifications that frequently foreclose participation to all but a single vendor (Landell-Mills, 2013; Martini, 2015; Transparencia Mexicana, 2012).
- 2) **Limit the Use of Less-Competitive Procurement Practices:** Direct contracts or restricted procurement auctions are a common site of corruption due to the heightened opacity in the contract award process. Various circumstances may necessitate the use of these otherwise less favorable methods. Such factors might include a particularly low contract value, a limited pool of qualified bidders, or a contract for highly complex goods or services. States should exhaustively enumerate the possible methods for procurement and clearly describe factors which would necessitate the use of each (Martini, 2015). In particular, where the contract amount is the determining factor, states should make clear, in absolute terms, the ceiling price for limited bidding or direct contracting (Transparencia Mexicana, 2012). Governments should automatically investigate contract values which exceed this ceiling yet were not awarded via an open auction.

The universe of possible procurement methods should generally follow the below categorizations:

- **Open Auction:** Publicly advertised auction amongst a wide variety of qualified vendors. Use as default process.
- **Restricted Auction:** Allows only the participation of pre-selected vendors—a process which should be publicly advertised and transparent. Use when necessary, as determined by pre-established objective criteria.
- **Negotiated Contract:** A contract whose terms are negotiated between the tenderer and vendor. Use when technical specification is impossible without vendor participation, when the initial tendering process failed to produce a winning vendor, or in response to an emergency or catastrophic event.

- **Direct or Single-Sourced Contract:** A contract that is directly awarded to a single bidder through a non-competitive process. Use in exceptional circumstances—where a contract value is very low, in response to an emergency or catastrophic event, in a monopolized industry, or in a project with national security concerns (Martini, 2015).

Regardless of the selected method, procurement processes and outcomes should always be published on the blockchain platform or affiliated e-procurement hub to maximize transparency and reduce discretionary decision-making.

Standardize Notices, Tenders, Bids, and Contracts

Non-standard bidding documents reduce transparency and increase discretion at various stages in the procurement process (Luijken & Martini 2014). From the initial auction notice to the final contract award, governments should specify the minimum information to be included in each document and notification. For example, tender documents could be required to include the bidding timeframe, the nature and frequency of communication during the procurement process, qualification requirements, award and rejection criteria, and any relevant legal terms and conditions (Martini, 2015). For the bidding documents in particular, best practices advocate the use of standardized language, where possible, to ensure uniformity, fairness, and transparency amongst procurement participants and across procurement auctions (Transparency International, 2014). In addition to reducing the opportunities for corruption, such measures will assist with monitoring and accountability by increasing comparability across sectors and over time. They may also increase procurement efficiency by streamlining document creation.

Mandate Transparent Price Benchmarking

Opaque or untethered price specifications within a procurement contract present significant opportunity for corruption. Tenderers and vendors alike should be required to provide multiple market-based price benchmarks to reduce the opportunity for self-interestedly inflated cost estimations. Requiring this type of market information is most challenging in the context of unique projects or in monopolized industries, where comparable products or services may be more difficult to encounter. Nonetheless, demanding that all tenders and bids contain, for example, three points of reliable market-based data to back each price estimation, is achievable in the overwhelming majority of contexts, could reduce discrepancies in contract pricing, and would provide procurement monitors with valuable information on the efficacy and honesty of contract execution.

Facilitate Citizen Audits

Countries ubiquitously staff official audit agencies or ombudsman offices tasked with anti-corruption monitoring (Landell-Mills, 2013; OECD, 2016). These institutionalized efforts should remain an emphasis within governments' anti-corruption frameworks and ideally should be backed by threat of sanction, as recommended by the OECD, UN, and WTO. However, government entities frequently lack incentive to properly conduct what are often onerous and expensive exercises of self-policing (Landell-Mills, 2013).

Consequently, over the past twenty years, organizations like Transparency International and Partnership for Transparency Fund have developed citizen-fueled auditing frameworks to complement government efforts, fill existing blind spots, and engage the broader public with the issue

of official corruption (Landell-Mills, 2013). Citizen monitoring can take various forms, the appropriateness of which may vary based on the cultural, political, and industry context. The monitoring process can be “open” or “closed,” with the former allowing the participation of the public at large, and the latter restricting the monitor team to a pre-selected group of reputable individuals (Basel Institute on Governance, 2015). Within closed processes, monitoring can fall to a specific civil society organization (CSO),¹⁷ a curated group of relevant experts, or a single individual. Ideally, citizen monitoring occurs throughout the procurement process—from the initial government needs assessment through contract completion (Gutman & Bhargava, 2015; Transparencia Mexicana, 2012). Regardless of the selected monitor model, experience has demonstrated that citizen audits are most effective when coordinated by a central body (i.e. a government agency, international organization, or CSO) to ensure the monitoring process is both comprehensive and efficient (Gutman & Bhargava, 2015).

Countries across the world have experimented with public procurement citizen monitoring programs in various forms—from public bid openings in Argentina and South Korea, to in-depth partnerships between CSOs and government agencies in the Philippines, to the strategic use of subject-matter experts in Mexico and Bulgaria (Gutman & Bhargava, 2015; Landell-Mills, 2013; Transparencia Mexicana, 2012). The information dissemination capacity of a blockchain-based procurement platform would organically magnify these efforts by publicizing documentation of, and insights into, the entire procurement auction (Landell-Mills, 2013). Nonetheless, a number of factors will remain key to the success of citizen monitoring:

- 1) **Legally Empower Citizen Monitors:** Whether by legislative decree or binding contract, the role of citizen monitors should be well-defined and backed by the force of law. To date, only a few countries legally mandate citizen monitors across the board (Gutman & Bhargava, 2015; Transparencia Mexicana, 2012). The more common approach is one that is applied on a case-by-case basis using legally binding agreements between the tenderer, the participating vendors, and the citizen monitors. For example, Transparency International’s “Integrity Pacts”¹⁸ clarify expectations and responsibilities and, through clearly enumerated standards and prohibitions, bind all parties involved to upholding a corruption-free procurement process. The anti-corruption standards contained in such agreements can mirror or exceed existing public law (Basel Institute on Governance, 2015).

These agreements serve two key purposes: (1) promoting a collaborative and supportive partnership between authorities and citizen monitors and (2) ensuring an even playing field amongst competing vendors (Bohem & Olaya, 2006; Gutman & Bhargava, 2015; Landell-Mills, 2013; Transparencia Mexicana, 2012). Each party to the agreement may report irregularities, which, if not remedied, can lead to dissolution of the agreement and sanctions against the offending party. Depending on the legal environment, the dispute resolution forum could be the national court system or an arbitral tribunal, though in practice, complaints rarely escalate to this level (Bohem & Olaya, 2006; Transparencia Mexicana, 2012).

Since the 1990s, Transparency International has helped launch hundreds of Integrity Pacts across more than twenty different countries producing a variety of well-documented positive

¹⁷ This can include community-based organizations, policy research centers, professional associations, faith-based groups, and the independent media (Landell-Mills, 2013).

¹⁸ For more information on Transparency International’s Integrity Pacts, visit https://www.transparency.org/whatwedo/tools/integrity_pacts/5.

outcomes at a low cost (Basel Institute on Governance, 2015; Gutman & Bhargava, 2015; Landell-Mills, 2013). They have been found to increase competition—even in historically monopolistic industries, decrease costs of public contracts, and enhance public perceptions of participating government agencies (Bohem & Olaya, 2006; Gutman & Bhargava, 2015; Landell-Mills, 2013; Transparencia Mexicana, 2012). However, if treated as a box-checking exercise, these results will not come to fruition. Ideally, the content of such an agreement should be pre-established (rather than negotiated), participation should be mandatory, and processes for flagging and sanctioning violations should be clearly defined (Basel Institute on Governance, 2015; Landell-Mills, 2013). To maintain these robust procedural safeguards, such agreements may be reserved for higher cost or higher risk government contracts (Transparencia Mexicana, 2012).

- 2) **Develop Easy-to-Use Monitor Tools:** Even when subject-matter experts are involved as procurement monitors, easy-to-use tools, such as checklists and report templates, greatly enhance the input, output, and overall experience of the monitoring process (Gutman & Bhargava, 2015; Landell-Mills, 2013). Best practices also advocate the development of only three to four key performance indicators to be assessed throughout the procurement process (Gutman & Bhargava, 2015). For example, Transparency International USA created the Civil Society Procurement Monitoring Tool, which is a web-based interactive guide and checklist where all monitors can share their experiences and flag concerns. Such tools can strategically focus the monitoring process and expand the pool of well-equipped monitors beyond those with specialized expertise (Basel Institute on Governance, 2015).
- 3) **Act on Citizen Findings:** “Nothing motivates more than seeing results from one’s work” (Gutman & Bhargava, 2015, p. 29). Citizen audits should be systematically disseminated and concerns should translate into prompt government action (Gutman & Bhargava, 2015; Landell-Mills, 2013). The sustainability of these initiatives is both a necessary condition and the greatest barrier to their success. While some sort of financial compensation—especially to cover monitoring costs—may be beneficial, citizen monitoring initiatives are largely fueled by a “spirit of volunteerism.” Experience from countries around the world has demonstrated that nothing incentivizes monitor retention more than receptive government agencies and systemic reform (Gutman & Bhargava, 2015).

Provide Safe and Efficient Avenues for Challenging Bids

Finally, as advocated by the OECD, WTO, and UN, governments should provide all stakeholders with a secure avenue for raising complaints throughout the procurement process. Whether through Integrity Pact-like agreements or more general avenues for citizen monitoring, the procedures and criteria for flagging and screening irregularities should be well-established and protection for whistleblowers should be guaranteed (Basel Institute on Governance, 2015). The anti-corruption potential of blockchain-based procurement can only be achieved if people feel empowered to act on the information they receive. Nonetheless, governments should embrace a constructive, as opposed to retaliatory, approach to managing complaints. Ultimately, transparent dialogue-driven processes best ensure the realization of a successful procurement process (Basel Institute on Governance, 2015).

The information dissemination capacity of blockchain opens an unprecedented avenue toward a more transparent procurement process. However, blockchain alone does not necessarily translate into increased accountability, fairness, and corruption prevention—the platform must be useful and it must be used. Through information consolidation, competitive vendor selection, and legally empowered

and protected citizen monitors governments can magnify the anti-corruption potential of blockchain-based procurement.

Additional Anti-corruption Use-Cases for Blockchain-based Platforms

The unique qualities that make blockchain a promising tool for improving transparency and accountability in public procurement also lend themselves well to a variety of additional public-sector and anti-corruption contexts. The examples below provide a sample of promising blockchain applications, as well as the barriers to implementation:

Land Title Registries

Various governments, including Brazil, Georgia, Honduras, India, and Sweden, have begun experimenting with blockchain-based land title registries. Some of these initiatives, like that in Sweden, are motivated by a desire to increase efficiency in a transaction-intensive industry, while others, such as those in Honduras and India, are intent on instilling and expanding property rights and enhancing transparency in a process susceptible to corrupt practices (Graglia & Mellon, 2018). Over 70 percent of the world's population is without a "legally registered" title to their land, which leaves people vulnerable to unjust seizures, particularly in resource-rich or corruption-prone regions (Shang & Price, 2018). Blockchain-based land registries provide a secure, decentralized, publicly verifiable, and immutable database through which individuals could definitively prove their land rights (Kriticos, 2019; Shang & Price, 2018). These qualities reduce the opportunity for self-interested manipulation of land registries or land rights and increase the resilience of land ownership more generally.

From timestamped records to digital escrows to detail-oriented registries, blockchain offers increased transparency and accountability in a space that is currently highly complex, precarious, or nonexistent. However, a number of administrative, legal, and technological barriers may block or stunt the realization of this potential. First, blockchain alone cannot formalize property ownership or solve ineffective governance. Countries with nonexistent, incomplete, or incorrect land registries need to go through the difficult process of gathering, cleaning, and digitizing this information before a blockchain-based land title registry can function (Graglia & Mellon, 2018; Kriticos, 2019; Vos et al., 2017). Conversely, these same environments—where land title is less entrenched and regulated—may provide a simpler regulatory context for blockchain integration, particularly if land reform is actively underway (Graglia & Mellon, 2018; Shang & Price, 2018).

Second, the degree of connectivity and tech savvy within a population may determine the feasibility of a blockchain-based land registry in the short-term. Unlike other blockchain applications, which require the participation of a smaller subset of individuals, a land registry could involve the active participation of the entire populous. Where internet proliferation or technological familiarity is low, the costs of tech support may make such an initiative impractical (Graglia & Mellon, 2018).

Third, while blockchain generally uses encrypted pseudonyms, which hide the identity of platform participants, this application of the technology conversely requires the identification of individual users—the entire purpose of such a registry is to tie the land title to a specific person. Consequently, a blockchain-based land title registry would have to be tied to a national identification system (Graglia & Mellon, 2018). Furthermore, given the high value of property interests, the registry should require multiple passcodes or biometric keys to reduce the likelihood of theft or fraud (Graglia & Mellon, 2018).

Blockchain-based land title registries can take a variety of forms and perform a variety of functions. To date, a number of examples exist at the more basic end of the spectrum of possibilities—generally providing complementary services to a pre-existing system or serving as a central catalog of land ownership (Vos et al., 2017). The more sophisticated and interactive iterations of a blockchain-based registry present additional challenges, including document storage capacity, land right disaggregation, and blockchain-based land exchanges (Graglia & Mellon, 2018; Vos et al., 2017).

Electronic Voting

Growing concern over election security, voter registration integrity, poll accessibility, and voter turnout has led governments to consider blockchain-based voting platforms (Kshetri & Voas, 2018). The decentralized, transparent, immutable, and encrypted qualities of such a system could minimize election tampering and enhance voter trust in democratic outcomes (Bulut et al., 2019). The ability to vote remotely might also increase citizen participation in elections.

Amongst otherwise small-scale deployments, the government of Estonia uses such a system in national elections and a few states in the United States use blockchain-based voting platforms to reach remote subpopulations, like deployed military personnel (e-estonia, n.d.; Mearian, 2019). In Estonia, voters use an ID-card or Mobile-ID to log onto the system during their designated pre-voting period. Upon vote submission, but before the vote is counted, identifying information is stripped from the ballot to ensure anonymity. Purportedly to reduce the possibility of fraudulent or forced ballot submissions, the system also allows users to vote an unlimited number of times prior to the vote deadline, with each subsequent vote cancelling out previous submissions (e-estonia, n.d.; Mearian, 2019). In the United States, deployed military personnel have recently been allowed to vote using a blockchain-based iPhone app. The app provides multiple biometric keys—facial recognition and thumb prints—for enhanced security, prevents compromised devices from submitting a ballot, and creates a paper trail for election officials and app users (Mearian, 2019; Rosenberg, 2020).

However, given the high stakes of elections, intelligence communities remain wary of the potential for such a system to be hacked or infected resulting in vote manipulation, paper trail erasure, or electoral chaos (Greenhalgh et al., 2018; Rosenberg, 2020; Specter et al., 2020). Furthermore, a voter verification system that uses biometric software, such as facial recognition, could lead to false positives or negatives in voter identification, thus facilitating fraud or disenfranchising citizens. Blockchain-based voting systems may also entail privacy risks and concerns, particularly if provided by private companies which may have less incentive to be forthcoming about their data management and security measures (Jefferson et al., 2019). Nonetheless, initial deployments of the technology in the United States reportedly improved voter turnout, produced accurate and verifiable results, and were well-received amongst blockchain-based voters (Fowler, 2020; Tusk Philanthropies, 2019).

Beneficial Corporate Ownership Registries

In most countries, companies can be formed without disclosing the identity of the ultimate financial beneficiary or owner. Recent corruption scandals have raised concerns worldwide regarding this type of opaque or undisclosed beneficial corporate ownership. Secretly operated companies can easily be used by political officials to launder money, pay bribes, or self-interestedly sway governmental investment, amongst other crimes (de Jong et al., 2017; Martini, 2019). Many countries are beginning to develop central registries for beneficial corporate ownership in order to better track conflicts of

interest and criminal activity. However, such systems remain the exception and existing registries overwhelmingly lack adequate verification processes (de Jong et al., 2017; Martini & Murphy, 2018).

Given the early stage of these initiatives, beneficial corporate ownership registries may be the ideal space for a blockchain intervention—information could be digitized and the technology integrated from the outset. Furthermore, blockchain responds directly to many of the present shortcomings of existing registries (de Jong et al., 2017; Martini & Murphy, 2018). It could provide a centralized and publicly viewable database with timely and individually verified entries. These qualities could be used to record complete ownership history and to ensure the authenticity and immutability of relevant documentation (Knobel, 2019). Furthermore, a blockchain-based digital platform opens the potential for globally-linked registries—a particularly important quality in a transnational context like corporate ownership (de Jong et al., 2017).

In addition to security concerns outlined in the two aforementioned blockchain applications, the recent emergence of these registries combined with the novelty of blockchain technology may pose certain challenges. For example, the majority of countries still do not require companies to maintain beneficial ownership information themselves. Furthermore, the adoption of a comprehensive and verifiable blockchain-based registry would require buy-in from politicians, lawyers, banks, and big business, many of whom may feel their interests are not served by the public transparency and auditability of such a system (Martini & Murphy, 2018).

Grant Disbursement Ledgers

Many governments annually disburse millions of dollars to support education, arts, humanitarian aid, and social assistance, amongst other causes. This process is frequently convoluted, opaque, and inefficient which causes money to be lost to banking fees and middlemen and opens the potential for corrupt financial diversions (Kanowitz, 2019; Suliman, 2017). Blockchain's transparent, immutable, and transaction-friendly nature lends itself well to the context of grant disbursements and could help build public trust in a system that is increasingly drawing skepticism from donors and recipients alike. Further, the ability to reduce the number of actors involved in grant awards, disbursements, and management, could significantly reduce costs, thus allowing more of the money to support the targeted organizations and initiatives. Recent blockchain deployments in this context include a pilot program in the municipality of Bahía Blanca in Buenos Aires, which focused on the city's arts and cultural grants; a yet-to-be launched program in the United States, which focuses on National Science Foundation grants; and a partnership amongst over three dozen leading international aid agencies, which aims to use blockchain to deliver humanitarian assistance around the globe (Altec, 2019; Kanowitz, 2019; Suliman, 2017).

However, the ability for recipients to effectively manage blockchain-based grant disbursements may prove challenging. While sophisticated organizations may be able to create blockchain funds, as demonstrated by UNICEF's recently established cryptocurrency fund, less technologically savvy or well-resourced individuals and organizations may face discrimination or exclusion from grant disbursement processes if they cannot adapt (UNICEF, 2019). Moreover, a blockchain-based disbursement system does not adequately address the challenge of corrupt practices in the use of the grant itself, which is frequently the case in humanitarian aid (Harvey, 2015).

Implementation Challenges

In addition to the more application-specific concerns just highlighted, there are some overarching hurdles that may stymie effective blockchain deployment. Many of these concerns echo those expressed in the procurement context. First, as mentioned above, the untested and energy-intensive nature of large-scale public blockchain platforms may pose a hurdle in contexts like blockchain-based land title registries or elections, which would require the platform to simultaneously support millions of users while maintaining high data security. As with public procurement, public-private hybrid platforms could offer a viable platform alternative (Graglia & Mellon, 2018). However, unlike procurement where active users could be restricted to tenderers and vendors, land registries and voting platforms would likely require a much larger pool of active users, which may prove unsustainable even on a hybrid system. Nonetheless, these technological barriers may be short-term as blockchain and other distributed ledger technologies continue to evolve.

Second, security is a real concern and all the more so when more is at stake. Whether it is someone's land title or their vote, electronic registries and transactions are more vulnerable to mass manipulation than traditional paper methods (Greenhalgh et al., 2018; Mearian, 2019). Blockchain offers a platform with greater security than the average webpage and superior traceability than the opaque and centralized status quo, but concerns over malware and hacker interference remain relevant.

Third, the immutability of blockchain presents both a blessing and a curse—it reduces opportunities for self-serving disclosure and information manipulation, but also makes errors irreversible. The aforementioned blockchain-based platforms would have to establish a system for error correction and input adjustment, in order to filter incorrect or outdated information from the public eye. Relatedly, the transparency-confidentiality balance in governmental applications of blockchain-based technologies is a sensitive one which requires careful consideration of the risks and interests at stake.

Fourth, political buy-in is essential. The aforementioned use-cases reduce opportunities for corruption by increasing the power of the people and leveraging the reliability of technology. This devolution of authority will not always be well received by governing bodies and other sources of power. If existing political and administrative institutions are not on board, the necessary regulatory adjustments and systemic integration cannot be achieved.

Finally, even when political powers are bought-in, permitting and then regulating these blockchain applications present novel challenges. As a base consideration, national laws and regulations need to fully embrace the legal power of smart contracts if blockchain-stored information is to possess weight under the law. More generally, to the extent that blockchain-oriented regulation exists, it frequently misunderstands or mischaracterizes the technology, which may trigger negative externalities originating from under-informed regulation or unexpected market consequences (Graglia & Mellon, 2018). Piloting blockchain implementation should flag and thus minimize certain unintended consequences, but some might not manifest until the technology is deployed at scale.

The novelty and untapped anti-corruption potential of blockchain-based solutions should not distract policymakers from the downsides and trade-offs associated with employing the technology in the public sphere. Nonetheless, blockchain presents unprecedented qualities that could enhance transparency, accountability, and citizen engagement in areas that materially impact democratic governance and sustainable development around the world.

APPENDIX A: PROJECT EVALUATION SURVEY TOOL

Survey Question	Performance Category
Were you satisfied with the transparency of the procurement platform?	Transparency
Were you satisfied with the amount of information released during the procurement process?	Transparency
Were you satisfied with the nature of the information released during the procurement process?	Transparency
Were you satisfied with the timeliness of the information released during the procurement process?	Transparency
Were you satisfied with the accessibility of the procurement platform?	Accountability
Were you satisfied with available complaint mechanisms?	Accountability
Were you satisfied with the expenses associated with the procurement platform? (i.e. personnel, resources, time, etc.)	Broader Measures of Performance
Were you satisfied with the ease of the procurement process?	Broader Measures of Performance
Were you satisfied with the reliability of the procurement platform?	Broader Measures of Performance
Were you satisfied with the technical infrastructure of the procurement platform?	Broader Measures of Performance
Were you satisfied with the security of the procurement platform? (i.e. data anonymity, hackability, etc.)	Broader Measures of Performance
Were you satisfied with the defined procedures of the procurement process?	Broader Measures of Performance
Were you satisfied with the technical and non-technical support you received?	Broader Measures of Performance
Were you satisfied with the platform's compatibility with existing procurement laws and regulations?	Broader Measures of Performance

Indexed on a scale of 1 to 5:

Not Satisfied



Somewhat Satisfied



Satisfied



Very Satisfied



Extremely Satisfied



Appendix B: Complementary Anti-Corruption Procurement Policies & Practices from Leading International Frameworks

In addition to the recommended complementary policies described in detail in this report, the below chart provides a more complete summary of procurement best practices advocated by leading international organizations. These norms and policies describe measures, which promote integrity, transparency, and accountability in distributed ledger- or standard internet-based e-procurement processes. The chart also connects each principle with one of the four anti-corruption-oriented key performance indicators (“goals”) addressed in the *Evaluating a Blockchain-based Procurement Platform* section. The referenced sources include the following: The UN Convention Against Corruption (UNCAC, 2003), the Model Law on Public Procurement developed by the UN Commission on International Trade Law (UNCITRAL, 2014), the OECD Recommendation of the Council on Public Procurement (OECD, 2015), the Revised Agreement on Public Procurement developed by the WTO (WTO, 2014), the Open Data Charter (ODC, 2015), and the Open Contracting Global Principles (OCP, n.d.).

Principle	Source(s)	Goal	Details
Professional standards for procurement officials or government officers who might otherwise influence procurement decisions—including disclosure of special interests	UNCAC UNCITRAL OECD	Transparency Accountability Prevention	Promotes adequate training of procurement officers and screening procedures to promote professional and objective processes.
Publication of procurement laws, regulations, general processes, and upcoming auctions	UNCITRAL WTO OECD	Transparency Fairness	Promotes broader participation and evens the playing field between veteran and first-time vendors
Publication and use of predetermined, objective criteria on vendor qualifications, bid-rejection, and contract award—ensuring such criteria are not unduly restrictive	UNCAC UNCITRAL WTO OECD	Transparency Accountability Prevention Fairness	Reduces room for discretionary procurement decisions and allows for subsequent verification.
Clear delineation of the permissible avenues for procurement and the factors under which each may occur—proscribes open, competitive auctions as the default procedure	UNCITRAL WTO OECD	Transparency Accountability Prevention Fairness	Reduces use of opaque procurement processes and removes discretion from the process of selecting a procurement method.
Timely, comprehensive, and high-quality data disclosure throughout the procurement process	UNCAC ODC OCP OECD	Transparency Prevention	Promotes meaningful data analysis and user feedback. Should also include data gathering methodology.
Accessible and usable data—including data literacy and capacity building opportunities for civil society	ODC OCP OECD	Transparency Accountability	Promotes the use of government data by civil society and the broader public through the elimination of digital, structural, and cognitive barriers to access.
Use of comparable and interoperable data across government agency, industry, country, and temporal contexts	ODC	Transparency Accountability	Promotes standardized data formatting—across agencies, industries, and countries—that maximizes human- and machine-readability.

Systematic documentation and archival records	UNCITRAL WTO	Transparency Accountability	Allows monitors to track repeat contract winners and past award/ rejection criteria. Facilitates temporal comparisons.
Improved procurement governance and proactive citizen engagement	ODC OCP WTO OECD	Transparency Accountability Prevention	Promotes government-citizen engagement—including the production of regular reports, the enforcement of the right to information, respect for freedom of expression, and citizen-driven policy proposals.
Effective and independent system of domestic review, appeal, and dispute resolution when procedural or legal violations are alleged	UNCAC UNCITRAL WTO OECD	Accountability Prevention Fairness	Provides an avenue for stakeholders to flag irregularities and rebut false allegations.
Appropriate sanctions for violations of procurement-related processes, agreements, or laws	UNCITRAL WTO OECD	Accountability	Raises costs of corrupt behavior through the threat of disqualification, blacklisting, or legal sanctions.
Systematic evaluation of procurement processes using predetermined key performance indicators	OECD	Transparency Accountability Prevention Fairness	Ensures all anti-corruption and general procurement goals are effectively pursued.

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