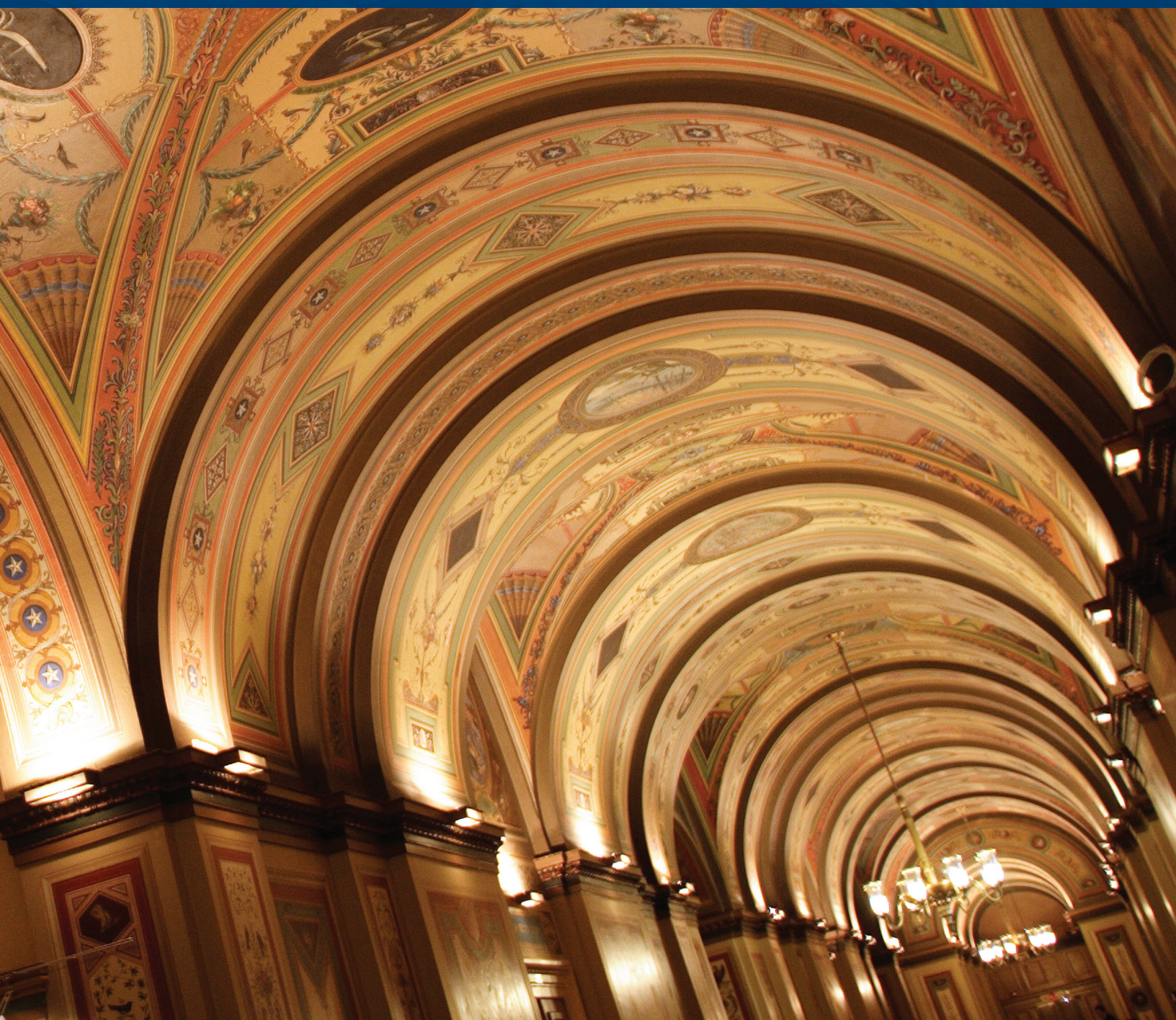# Tech for Integrity

Corporate and Investment Banking

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Tech for Integrity[1]

A week doesn't go by without a news article somewhere about a government-involved corruption scandal. The explosion of corruption onto our front pages and into mainstream debate creates the impression of a new epidemic – a recent surge in global corruption with tentacles deep into the public sector space. In fact, in a recent Kroll survey of global executives, 40% of those asked said they believe bribery and corruption risks are increasing.[2] According to Transparency International, some 58% of Africans across the continent said corruption is on the rise.[3]

Jay Collins
Vice Chairman,
Corporate and
Investment Banking,
Citi

That said, it is just as possible that recent global public frustration with governments, combined with the extraordinary spread of information communication technology (ICT), have simply shined a very powerful new spotlight into the longstanding dark room of corruption; the absolute magnitude of corruption may not be new, rather the world is simply discovering more of it and tolerating less.[4] As the digital age pulls back the curtain on today's global "integrity" issues, the systematic application of technology will give us an opportunity for game-changing progress in the fight for integrity.

Needless to say, corruption, or the abuse of entrusted power for private gain, comes at enormous economic and social cost.[5] It destroys the very trust that underpins democratic values and institutions, and puts cracks in the social contract that binds us together.[6] 60% of young people see corruption as the most serious issue facing their local communities and the most important factor driving inequality.[7] From a purely economic standpoint, according to the IMF, corruption is a tax on investors, undermining outcomes in virtually every global industry.[8] While estimates vary, the WEF puts the cost of corruption at 5% of global GDP, or approximately $3.7 trillion dollars.[9]

[2] Kroll Survey, *"2016 Anti-Bribery and Corruption Benchmarking Report,"* 2016

[3] Transparency International, *"People and Corruption: Africa Survey,"* 2015

[4] U4, *"Mixed Incentives: Adopting ICT Innovations for Transparency, Accountability, and Anti-bribery,"* 2014

[5] Transparency International, *"What is Corruption?"*

[6] *"The Fourth Industrial Revolution,"* Klaus Schwab, 2016

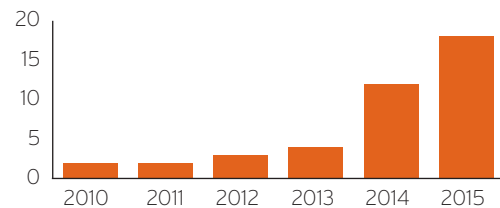[7] World Economic Forum

[8] IMF, *"Corruption Matters,"* September 2015

[9] OECD, *"The Rationale for Fighting Corruption,"* 2013 and World Bank Global GDP

Needless to say, corruption, or the abuse of entrusted power for private gain, comes at enormous economic and social cost.

Private Investment

Private investment in Global FinTech companies ($bn)

Source: Citi and CB Insights; Includes first round and subsequent private investments.

From a business perspective, Angel Gurria of the OECD estimates that corruption adds 10% to the global cost of doing business and 25% to public contracts.[10] Yet it is the world's poor that are hardest hit! Over 1.6 billion people annually have to pay a petty bribe to receive public services, an astounding number.[11] Recognizing this, the world's new Sustainable Development Goals (SDGs), specifically SDG 16.5, targets substantially reducing corruption and bribery in all its forms.[12]

The search for a new paradigm of integrity is now "top of mind" for the world's political and economic leaders. A recent WEF survey points to 67 countries that consider corruption to be one of their top three problems.[13] ICT may not be a magic bullet, but it is arguably the most powerful tool in the integrity tool kit. While governments have recognized this for years, the pace of technological advances is now supercharging these tools.[14]

The inappropriate movement of money, payments and collections of any kind in the public sector is fundamentally enabled by legacy paper, manual and cash processes that only defy digital gravity by avoiding it all together. There has been significant progress in governments adopting electronic payments and collections, including the use of procurement and benefit cards to make payments. We have seen governments successfully implement mobile wallet payment and digital identity solutions; however, given the possibilities of existing and frontier technologies, we have only seen the tip of the iceberg.[15]

While some may disagree, despite its historical significance and habitual societal entrenchment, cash is bad.[16] Several years ago developmental organizations, including the UN and USAID, began an initiative supported by Citi that is directed at the poorest of the world's population called the "Better than Cash Alliance."[17] Around the time of the launch of the Better than Cash Alliance, Citi and USAID published its Mobile Wallet Accelerator Principles, most of which are still highly relevant today. The Principles were driven by the belief that mobile phones, which are in the hands of 2 billion of the world's poorest, could be transformational in connecting the poor to the economy and financial system. The fundamental objective of these mobile payment ecosystems is to replace cash, and by doing so, open up the door to a myriad of financially inclusive digital developmental solutions.[18]

Commercial transactions in cash create a lack of transparency that contributes to suffocatingly low revenue to GDP ratios in the developing world.[19] Citi estimates that a mere 10% improvement digitizing monetary flows has the potential to shift over $1 trillion dollars into the formal

[10] B20 Task Force on Improving Transparency and Anti-Corruption Speech, Angel Gurria, 2012

[11] U4, "Reducing Bribery for Public Services Delivered to Citizens," 2015

[12] United Nations, Sustainable Development Goals

[13] CSIS, "Costs of Corruption," February 2014. 144 countries were surveyed.

[14] Bain Report, "Future of Government Smart Toolbox," June 2014

[15] CSIS, 2014

[16] Willem Buiter Op-Ed, "Toward the Brave New World of Negative Rates and a Cashless Society," March 2016

[17] UN, Better Than Cash Alliance, https://www.betterthancash.org/about

[18] USAID, Citi, "10 Ways to Accelerate Mobile Money," 2012

[19] Brookings, "Can Corruption Adversely Affect Public Finances in Industrialized Countries?," April 19, 2010

economy.[20] Further, Citi estimates that $350-$400 million can be saved by converting cash payments to digital.[21, 22] Yet, digital is disruptive, and many of the frontier solutions are still being developed. Just as the digital revolution has turned many industries on their head, from media to music and taxis to hotels, it is at the early stage of disrupting financial and government services.[23]

The financial technology (FinTech) feeding this disruption is aimed at cash; 70% of the $19 billion spent on FinTech investments in 2015 was focused on the last mile, where the electronic payment chain breaks down.[24] From Kenya's digital wallets to India's digital identity, to the disruption witnessed in P2P lending in China, the framework that anchors major components of our regulatory and financial system are being challenged.[25] At the same time, this disruption requires new thinking around the safety and security demands of citizens. Governments should embrace technology with this in mind; CX must be the new UX.[26]

Today, there are over 200 digital currencies in existence, the most well-known and first of many being Bitcoin, a decentralized "cryptocurrency."[27] Bitcoin developed its reputation as an anti-establishment, anti-centralized-trust, autonomous organization, which created opportunities for illicit financial flows beyond the reach of regulators and law enforcement. The extraordinary irony is that bitcoin's technology platform, blockchain, may end up being one of the most significant integrity tools ever created. Blockchain is a platform that records and verifies transactions on a distributed database, or ledger, and is transparent, traceable and immutable.[28]

Steve Johnson, in his seminal book on innovation, talks about "exaptation," where a mature technology is borrowed from one area to solve an unrelated problem in another area.[29] Bitcoin's original purpose was to allow non-trusting parties to transact in a secure manner without a trusted intermediary. The "exaptation" of Bitcoin's blockchain technology is likely to be a world of many, many blockchain platforms, with extraordinary wide ranges of permutations on the distributed ledger theme, including ones where there is, in fact, a third party of trust controlling and administering the chain.[30] Some blockchain platforms will increasingly be permissioned, centralized while still distributed, where a government or Central Bank can have special permission to control a "master ledger," with layers of permissioning depending on circles of trust.[31]

Blockchain technology — for all its current uncertainties and risks — has the potential to challenge the backbone of global payment channels. The concept of a distributed ledger is not only potentially disruptive to centralized clearing as we know it, but also to all the legacy norms imbedded in and around paper currency, from economic policies and monetary policies to security policies and core social values.[32] These challenges have moved into the rooms of regulators and Central Banks, as these Decentralized Autonomous Organizations, like Bitcoin, take aim at the heart of Central Banks' trusted third-party role, causing many to be skeptical, cautious or outright concerned.[33]

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[20] Citi Digital Money Index, *"Getting Ready for Digital money, A Roadmap,"* 2014

[21] Estimate is based on digitizing a quarter of the existing cash-based flows in select high frequency use-cases

[22] Citi Digital Money Index, *"Releasing the Flow of Digital Money: Hitting the Tipping Point,"* 2016

[23] Citi Global Perspectives and Solutions Report, *"Digital Disruption,"* March 2016

[24] Citi Digital Money Index, 2014

[25] Transparency International, *"Technology Against Corruption,"* May 2013

[26] Citizen Experience must be the new User Experience

[27] *"Decentralized Applications: Harnessing Bitcoin's Blockchain Technology,"* Siraj Raval, 2016

[28] *"Blockchain Revolution,"* Don Tapscott and Alex Tapscott, 2016

[29] *"Where Good Ideas Come From,"* Steve Johnson, 2010

[30] Tapscott, 2016

[31] Tapscott, 2016

[32] MIT, *"Blockchain and Financial Services: The Fifth Horizon of Networked Innovation,"* May 2016

[33] Raval, 2016

Despite these uncertainties, the power of having an immutable distributed ledger has meant that some governments have already begun using blockchain platforms. One use case is as an asset registry, for validation of physical world assets. For example, governments can immutably record real estate ledgers, data related to official development assistance, government assets, data related to monitoring of customs duties, or taxes of any kind. Estonia, Honduras, Ukraine, India, among others, have already implemented such blockchain platform solutions.[34]

In order to fully understand the power and potential of blockchain technology, one must understand smart contracts.[35] Smart contracts will be transformational, as they will allow the electronic exchange of digital value or real assets to be programmed into a blockchain platform. Think of a smart contract as a contract made digital that executes itself autonomously based on certain programmed conditions. When the contract is made immutable by being put onto a blockchain as code, it becomes transparent and searchable. Imagine, therefore, in a world of smart contracts, a government being able to electronically audit digital contracts across an entire procurement supply chain, including the financing components. Integrity becomes exponentially easier to accomplish in a world of smart contracts.

Some Central Banks have come to see the fintech revolution – blockchain, smart contracts and the variety of related technologies – as a digital freight train that can't be stopped. A number of Central Banks are, therefore, constructively engaging with these new realities to understand them, use them, adapt them and regulate them. Regulators, like the Monetary Authority of Singapore, are even bear-hugging these technologies, proactively investigating, sandboxing, and kicking the tires to help shape their future use.[36] Such regulators will be the

ones that dominate the new field of "RegTech," where the regulators themselves use cutting-edge technologies to continue to successfully perform their function in the digital age.[37]

There is extraordinary brainpower in Central Banks today focused on looking at digital currencies and their potential. Many are testing and modeling their own potential parallel national digital currency, while others have struggled and pulled back. These potential Central Bank owned digital currencies will strive to utilize the underpinning of a blockchain platform, while re-introducing the centralized safety, trust, reliability and "regulatable" components of their role.[38] Some are attempting to project the resulting impact of these currencies on the economy. The Bank of England, for example, has modeled a national digital currency (a digital pound) projecting a potential 3% annual increase in GDP.[39] Even with the extensive thought, modeling and experimentation, the issues are still highly complex. Yet, that will not necessarily slow the train.

As blockchain and its derivatives come to life, the potential of monster-size big data analytics used to supercharge the integrity fight is also significant. Artificial intelligence, machine learning and predictive analytics will allow powerful virtual "search and destroy" missions to be waged against corruption over the internet.[40] While Citi, Mastercard and others have been running complicated anti-corruption algorithms on government flows for years, advanced technologies run by groups like Darktrace and Arachne will likely take this to a whole new level.[41]

When we add the advances in biometrics (facial, voice and fingerprints) that will allow digital and multi-factor identity to combine with device, location and behavioral identity techniques, we will see a leapfrog in progress in

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[34] Tapscott, 2016

[35] *"The Business Blockchain,"* William Mougayar, 2016

[36] Coin Desk, *"Singapore Central Bank Funds Blockchain Recordkeeping Project,"* July 2015

[37] Duhaimes's AML Law in Canada, *"Fintech and Terrorist Financing – a major RegTech issue,"* January 27, 2016

[38] Tapscott, 2016

[39] Bank of England Working Paper, *"The Macroeconomics of Central Bank Issued Digital Currencies,"* John Barrdear and Michael Kumhof, July 2016

[40] Tapscott, 2016

[41] Transparency International, *"The Potential of Fighting Corruption Through Data Mining,"* 2015

We will have to build a new social consensus around the appropriate rules, laws and regulations for the fast-changing digital age.

the identity space.[42] This will not stop or defeat the challenges of cybersecurity, which will not be addressed here, but will at least create helpful defenses.[43] Identity improvements will, however, radically change the dynamics of the so called "last mile" of the financial inclusion challenge and add another major arrow to the anti-corruption quiver.

The digital world of the future will increasingly be networked, open and collaborative, creating exciting opportunities for integrity initiatives, but only if governments embrace those same concepts.[44] Open Application Programming Interface (Open-API), tools that enable software systems to communicate, will increasingly become the norm, with the opportunity to take an Appstore approach to technology solutions that solve government problems. This connected world, when bolted to the Internet of Things (IoT) through a trillion sensors, will take transparency to new levels, as it will add physical assets to the already monumental amount of data captured and subject to advanced analytics.[45]

These connected technologies will change the development landscape, as they have the potential to extract manual processes, paper documentation and cash from development flows. When the last mile is made digital and

transparent, and information and money can flow freely both ways, the spotlight on the entire digital chain will be bright and the myriad of corruption flash points will become muted.

All of these technologies can be applied to issues surrounding Anti-Money Laundering and Counter Financial Terrorism (AML-CFT) and should encourage regulators and law enforcement to expand their work with fintech and bank players. Promotion of technologies that automate and reduce the cost of the Know Your Customer (KYC) and AML-CFT processes will reap enormous rewards.[46] We should use the full array of technology in our arsenal for this fight. IDmission is one example of a company using integrated cloud-based capabilities, biometric identity solutions, data analytics and know-how on cross-border regulation to drive KYC and AML solutions globally.[47]

While many of the emerging technologies will have to be adapted, tested, scaled and perfected, the bigger challenge may well be in changing societies' paradigms. We will have to build a new social consensus around the appropriate rules, laws and regulations for the fast-changing digital age. Issues like thresholds of privacy, digital safety, security and protection, and citizen experience (CX) need to be urgently addressed.

Johnson writes about how technologies create building blocks that open new doors to solutions previously unthinkable.[48] Take as an example the advent and convergence of broadband, the internet and digital compression technology that gave us YouTube. Johnson calls this concept the "adjacent possible." Emerging fintech and the convergence of multiple technological building blocks are opening the door to brilliant new ways to apply technology to the needs of citizens and the role of government; if we relentlessly explore and apply the technologies in our "adjacent possible," we can win the integrity battle. ■

[42] IJCSNS International Journal of Computer Science and Network Security, *"Online Identity Theft and Its Prevention Using Threshold Cryptography,"* Sept. 2010

[43] Citi Perspectives, *"Responding to Cyber Threats through Public and Private Partnerships,"* 2014

[44] MIT, 2016

[45] Schwab, 2016

[46] Financial Action Task Force

[47] IDmission was a Citi Mobile Challenge winner

[48] Johnson, 2010

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We will not be judged on the speed of commercialization or lifestyle improvements, but instead on how well society applied technological advances to solve the greatest challenges of our time.

Tech for Integrity, Part II[1]

The first part of this paper, published last year, identified corruption as one of the greatest challenges of our time and outlined ways in which technology can help to defeat it. This second part of the paper, also by Jay Collins, Vice Chairman, Corporate and Investment Banking, Citi, highlights a series of innovations that are already delivering results in the fight against corruption.

When our grandchildren read the history of the technological surge we are now living through as part of the Fourth Industrial Revolution, we will not be judged on the speed of commercialization or lifestyle improvements, but instead on how well society applied technological advances to solve the greatest challenges of our time, such as corruption.[2, 3]

Where do we start? First, by relentlessly applying new and existing technologies, we have to clearly identify corruption pain points. Second, we need technology innovators, big and small, to focus their firepower and develop solutions that address them. Third, the public and private sector need to work together to implement these solutions. This paper will discuss steps one and two, as well as provide a road map and a call to action on step three.

Before jumping into specific pain points and solutions, it is important to explain the background to this paper: an 18-month global public private partnership called the Citi Tech for Integrity (T4I) Challenge.[4] This collaborative effort began in early 2016 during a Citi brainstorming session on how to use crowdsourcing as an open innovation methodology to tackle a major global challenge. Having studied the United Nation's Sustainable Development Goals, we were struck by the magnitude of the corruption challenge (SDG 16.5) and how interested our global clients were in finding solutions. We knew that multiple technological building blocks had opened the door to potentially game-changing anti-corruption solutions and that many of Citi's most innovative clients would embrace a focused open innovation effort to 'do good' and 'do well' at the same time.[5]

As a result, T4I was born. Citi was joined by Mastercard, Microsoft, IBM, Facebook, Clifford Chance, Let's Talk Payments and PWC to launch T4I. These strategic allies were also supported by over 70 governments, NGOs and multilateral organizations such as the UNDP, IADB and the World Bank.

We kick-started T4I at Davos in early 2017, and began by crowdsourcing integrity pain points from subject matter experts bucketed into eight pain point pillars.[6] From several hundred qualified registrants, we selected 213 to be put through the T4I accelerator program, and ultimately selected 96 companies to showcase their solutions in six countries around the world between May and June 2017. In October, the IMF will host an award ceremony to recognize companies with game-changing integrity solutions. The solution examples provided in this paper are drawn from participants in the T4I Challenge.[7]

1. Cutting red tape

Paper document and manual processes create opportunities for corruption: T4I identifies a myriad of companies that responded to this challenge by using digital document management and workflow efficiency solutions that cut red tape and processes that facilitate corruption. As corruption festers in paper-based manual processing environments, T4I found a myriad of companies that responded to the Challenge with digital document management and workflow efficiency solutions. These workflow management solutions electronify data, automate processes, and then typically bolt on more technologically advanced solutions like digital signatures and identities, and digital document management and security. For example, Citygrows is electronifying paper documents and automating manual processes, simplifying execution, and digitizing and securing data in the cloud.[8]

A plethora of solutions used a "permissioned" blockchain backbone, where the blockchain acts as an immutable, digital data registry on which other functionality relies. Public official asset and liability declaration systems, for example, are difficult to search or audit when they are in paper form. However, when this information is put on a blockchain platform, it can be cross-checked against multiple databases for anomalies and incongruent information by using artificial intelligence (AI).

For example, Wallet.Services, which provides workflow solutions to over 100 agencies of the Government of Scotland, tailors batch data management (BDM) workflow solutions on a permissioned blockchain platform built using Microsoft Azure.[9]

Digital documentation brings many challenges and opportunities, including the need for e-signature controls and authentication; sorting and prioritizing volumes of data; securely maintaining sensitive information; e-signature protocols, authorization systems and electronic data management protocols are therefore critical. Companies like Dathena, which uses Nvidia's AI, and Singapore's Taiger can identify, classify and categorize documents and then analyze the documents for potential cases of fraud and corruption.[10, 11]

2. Analytics, reporting and transparency

The raw processing power now exists to run extremely complex algorithms at a speed and cost efficiency that was unthinkable in the recent past. Data is being electronified and stored at a breakneck pace; digital data is expected to grow at a 42% compound annual growth rate until 2020.[12] As computational costs continue to decline, the phenomenal growth in digital data is providing a training pool for machine learning protocols focused on integrity issues.[13]

Data storage policies have changed from selectively stored structured data in curated warehouses to cloud-based unstructured data lakes. Open data, open contracting and open government efficiency disclosures allow for much Greater data to be made available for public scrutiny. Furthermore, cloud infrastructure for sharing and accessing data is increasingly automated, flexible, secure and cost efficient.

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[6] techforintegritychallenge.com/images/content/Citi_T4I_Integrity_Pain_Points.pdf?v=

[7] techforintegritychallenge.com/images/content/Citi-Tech-For-Integrity-Challenge-Demo-Day-Finalists.pdf?v=

[8] Citygrows, citygro.ws Other companies in this market include: Seamlessdocs, Acela, Socrata and Dept of Better Technology

[9] Wallet.Services, www.wallet.services

[10] Dathena, www.dathena.io

[11] Taiger, www.taiger.com

[12] Citi Ventures Research

[13] Mkomo.com

The massive scale and breadth of ongoing global digitization of data doesn't just bring promise; unfortunately, connectivity and digitization have ushered in the peril of cyber threats. The world has yet to develop a credible response to the magnitude of increasing vulnerabilities posed by nation-state and non-nation state cyber actors. These actors threaten our network and cloud where the keys to the modern functionality of society are held. Tech for integrity tools require trust in order to be implemented, and greater cybersecurity is required to anchor that trust.

Many of the T4I finalists developed specific solutions that address data management challenges as well as more advanced tools that organize and analyze different types of data. One example is Privitar's solution, which sorts through large pools of data, and identifies, manages and protects sensitive data.[14]

Because not all data is script, it has become increasingly important to analyze multi-form, unstructured audio and video data for fraud and integrity anomalies. Companies like Deepgram and Nice Actimize's "ABC" solution use AI to analyze such data with enormous efficiency and accuracy, and are able to detect integrity anomalies.[15, 16]

As data increasingly moves through digital devices, solutions that can detect device fraud are also critical. Precognitive, for example, is a U.S. SaaS fraud prevention company that can look at device behavioral vulnerabilities and apply predictive analytics against aggregated device data.[17]

Finally, while 80% of all online data has location data imbedded in it, 90% of that data is left unused. Spanish company CARTO is commercializing solutions based on advanced algorithms that analyze and provide real-time visualization and predictive insights using location data.[18]

3. Identity
One of the fastest growing global crimes is identity theft; the absence of a straightforward way to prove identity feeds bribery, contributes to fraud and creates barriers to financial inclusion. A shocking 1.1 billion people in the world still lack a legal identity.[19]

During the T4I challenge, we saw numerous advancements in biometric, behavioral, device and token-driven solutions that together can drive a surge in global identity initiatives and other fintech innovation. The way to unlock the fintech toolkit is often with a robust identity key; similarly, little can be accomplished without first solving identity issues.

Multi-factor, layered identity solutions used for identity onboarding and verification, or for transaction authorization, increasingly draw on ever-advancing biometrics. PAYYAP, for example, has added IBM voice authentication technology to its e-commerce payment solutions[20] and Chile's TOC biometrics is commercializing multi-factor biometric identity approaches for its document solutions.[21] Facial recognition tools are increasingly used, yet like voice recognition tools, need to protect against replicas and replay attacks. iProov, a company working with the UK government, is addressing this need with its color flash technology, which is combined with a layer of machine learning to provide high-grade facial recognition.[22]

Capturing and utilizing multi-source data to add additional identity security is an increasingly used methodology. ID.me, a company which is a US Government service provider, has a solution that allows veterans and other citizens to access multiple government services and benefits through one portal with a single sign-on.[23] In addition to being convenient for citizens, the solution combines multi-factor and multi-layer identity tools to maximize identity verification, including external credit bureaus, telco data,

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[14] Privitar, www.privitar.com

[15] Deepgram, www.deepgram.com

[16] Nice Actimize www.niceactimize.com

[17] Precognitive, precognitive.io

[18] CARTO, carto.com

[19] World Bank Group, ID4D, 2017

[20] PAYYAP, PAYYAP.network

[21] TOC biometrics, crediwatch.com

[22] iProov, www.iproov.com.

[23] Id.me, www.id.me

fraud algorithms, social media verification, and machine vision (imaging inspection).

4. Government transactions and payment processes

Not unsurprisingly, government payment processes with human interaction create a plethora of integrity pain points. If we seek to reduce the number of global bribes paid, for example, we have to target physical interactions between recipient citizens and distributing public officials. Too many governments distribute benefits without appropriate controls or verification mechanisms; often recipients falsely claim entitlements, receive a benefit more than once, or do not use the benefit as intended.

A perfect example of this is conditional cash transfers (CCTs), which make a benefit dependent on a corresponding activity or behavior, such as educational stipends for school attendance, or health payments linked to receiving a vaccine. CCTs are a conceptually fantastic way to improve benefit incentives and impact, yet have introduced burdensome paper and manual administrative bureaucracy into the payment process, increasing the potential for corruption.

Digital integrity solutions applied to CCTs change this paradigm completely, electronifying and automating the authorization and payment process. Companies like PALPAY, a joint venture between Bank of Palestine and PCNC Solutions, and Myndgenie in India identify both the benefit recipient and the authorized condition certification professional, electronify the certification process, and then automatically release a benefit payment. This radically reduces the potential for corruption and provides hard data impact analysis for benefit programs.[24, 25] Mindgate, also in India, built an event and rule-based engine that automates conditional benefit programs, driving down leakage of their programs from 30% to near zero and taking the certification and payment process from 180 days to only three days.[26] Mindgate also uses Aadhaar, India's biometric identity program, which is driving the country's extraordinary progress towards financial inclusion.

Digital workflow process management tools have enormous benefit when applied to the procurement process.

Governments also conduct frequent and large transactions with corporations, which, when run manually, make proper oversight and auditing difficult. The electronification of government transactional processes, like tax administration, customs procedures, or the reallocation of public funds or assets, all represent transactions that could be radically improved by digital systems.

One example of a frequent governmental transaction with multiple pain points is an asset sale by a government; governments frequently monetize small and medium-size assets, from real estate and cars, to computers, furniture and confiscated property. Often this sales process is bureaucratic, and any potentially competitive bidding process may be subject to collusion and limitations on participation and transparency, as well as price manipulation, resulting in lower proceeds for the government.

Ukraine is a good example of this problem; oligarchic behavior and 25,000 tender committees have repeatedly produced limited participation auctions costing the government of Ukraine $2 billion a year.[27] An innovative solution was developed and deployed by Prozorro. Sale, an open source, non-profit, funded by

[24] PALPAY, palpay.ps/language/en/home/

[25] Myndgenie, www.myndgenie.in/

[26] Mindgate, www.mindgate.in

[27] Transparency International Ukraine, ti-ukraine.org/en/projects/innovative-projects/prozorro-sale/

Transparency International, a T4I Contributor. The solution layers a centralized database on top of multiple e-auction platforms, allowing the Ukrainian government to provide real-time, transparent buyer data via API and creating unfettered auditable competition among a variety of commercial auction platforms.[28]

5. Public procurement and beneficial ownership

Annually, there is an estimated $9.5 trillion dollars spent on global public sector contracts; it is estimated that corruption adds up to 10% of the total cost of doing business globally, and up to 25% of the cost of procurement contracts in developing countries.[29] Public procurement processes often lack end-to-end transparency. From bid announcement to project requirements, from the status of bid evaluations to the awards process, through to the monitoring of project implementation against project commitments, technology-driven solutions are now available to provide end-to-end transparency.

In order to achieve greater accountability for public purchasing decisions, digital records must be searchable and auditable. Coordination and communication among public procurement entities is often weak; there is a clear need to automate bidder eligibility verification across government so that disclosure of debarments and suspensions is consistent.

For example, big data and automated analytical tools can detect vendor reputational issues, bid rigging, phantom vendors, price fixing, repeat awards to the same vendor and vendor beneficial ownership issues. Crediwatch, for example, uses advanced algorithms to provide a snapshot of any potential government vendor by using 25,000 public data points, providing real-time risk insights.[30]

Digital workflow process management tools also have enormous benefit when applied to the procurement process. End-to-end procurement solutions delivered via API, like those developed by Commugen, are increasingly compelling as can simply be bolted into toolkits by

governments.[31] Another solution, Teneris by Argentina's Signatura, tackles tender offers, requests for proposals and sealed bid auction processes by providing a blockchain document management tool with digital signatures and document verification protocols.[32]

Technology is required for better monitoring of bid specifications in ongoing projects; often bidders seek to substitute lower quality goods and services during the contract implementation phase in order to recoup the expense of bribes paid to win the mandate. Workflow oversight, where integrity checks are conducted during the execution of complex procured services, is perhaps most needed in the infrastructure space. India's SuperWise, for example, ensures remote infrastructure construction control and transparency by providing workflow oversight using supply data input, worker and supervisor mobile apps, digital workflow, geo-location capabilities and picture content to tackle integrity issues in the infrastructure sector.[33]

AI is a game changing tool when applied to procurement. Taiger, for example, uses multiple AI disciplines to automatically extract and interpret information from structured and semi-structured documents (contracts, powers of attorney, emails, tax documents, financial statements, etc.).[34] In addition to reducing processing time from weeks to minutes and delivering extraordinary cost and operational risk benefits, Taiger is a powerful anti-corruption tool. While Taiger is initially targeting bank clients, its integrity applications offer enormous potential benefits for government procurement and tax departments.

6. Crisis management and aid

Pain points associated with identity challenges relate directly to the challenges of providing aid payments in remote areas to refugees, victims of civil conflict and natural disasters. Remote and operationally challenging geographies, when combined with unbanked and unidentified individuals, create a burning need to develop quick and efficient identity onboarding tools that can be appropriately used

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[28] Prozorro.Sale, www.prozorro.sale; ti-ukraine.org

[29] OECD, www.oecd.org/g20/topics/anti-corruption/oecdanactivepartneroftheg20andb20intheglobalfightagainstcorruption.htm

[30] Crediwatch, crediwatch.com

[31] Commugen, www.commugen.com

[32] Signatura, signatura.co

[33] SuperWise, superwise.site.

[34] Taiger, www.taiger.com

across government, aid and developmental organizations. Corruption pain points are magnified exponentially when there are identity problems, as many organizations by default use cash distributions.

The lack of "last mile" digital connectivity has been a major issue in crisis fund distribution not just because of the high fraud and corruption possibilities, but also because official aid organizations and NGOs face funding challenges when their impact analysis is undercut by a "blind" cash component of the distribution supply chain. Impact analysis that includes last mile digital information often contains rich meaningful data that is linked to the flow of funds.

Digital crisis fund distribution options that are better than cash from an integrity perspective are cards and mobile wallets. As mobile wallet ecosystems are rolled out and gain critical mass, mobile payment options will become a more effective tool for crisis relief management. However, mobile wallet payment and collection benefits, combined with data exchange and location-based technologies, are only achievable with sustainable telecommunication and energy infrastructure.

While vanilla pre-paid cards have been tried and tested in those environments, technology and cost efficiencies driven in large part by investments by companies like Mastercard have launched a smart card revolution. The T4I Challenge highlighted a number of companies implementing card solutions with new onboarding techniques, advanced biometrics, reloadable functionality, robust transparent and analytical back ends, and an ability to function with or without internet connectivity.

Some of the most interesting financial inclusion innovators are using SMS, unstructured supplementary service data, radio-frequency identification (RFID), and near-field communication technologies to bring the benefit of electronification of information and payments to the last mile, without relying on internet infrastructure connectivity; these low-tech, or "flex-tech" solutions are ideal for remote financial

inclusion initiatives or for emergency government responses to natural disasters or refugee crises.

For example, Paycode, in Ghana, has combined a smart card, a biometric identity solution and a "bank in a box" model that does not rely on internet connectivity to function. The Paycode solution has significantly reduced fraud, particularly associated with "ghost workers," who are on the payroll system, but who do not work for the organization.[35] Nultan has a contactless tap RFID payment solution, specifically designed for the transportation sector in Nigeria, allowing fast non-cash payments without the need for internet. This enables citizens using the bus, for example, to board and pay quickly, avoiding graft.[36]

Meeting the impact analysis needs of the official development assistance community is greatly facilitated by the combination of multiple digital tools. AID:Tech, an Irish company that has proven itself to world class NGOs and large developmental institutions, demonstrated just such a multi-tiered aid solution during T4I; its service integrates advanced identity solutions and data analytics designed to meet very specific aid impact needs. AID:Tech is also an example of a company built on a blockchain platform, which makes distribution records immutable, transparent, auditable and searchable.[37]

Finally, aid often includes non-cash distributions. In addition to identity technologies and advances in mobile wallet and card capabilities, PALPAY, for example, uses RFID technology to distribute and track non-cash supplies to crisis recipients.[38]

7. Ethics, engagement and education
There is little doubt that education and citizen engagement can contribute enormously to ethical behavior. As ethical societal norms are established at a young age, the problems of corruption need to be taught early through a variety of tools, including gamified learning. In order to deconstruct the cultural foundation on which corruption is built, there is a need to teach citizens about what constitutes corruption and what can, and should, be done to fight it.

[35] Paycode, www. paycode.com

[36] Nultan, www.nultan.com

[37] AID:Tech, www.aid.technology

[38] PalPay, palpay.ps/language/en/home/

Australia's ArcLife provides ethical and anti-corruption training, includes online courses, connectivity policy "snapshot" tools, and best practices.[39]

Technology-based awareness campaigns that help modify the perception that corruption is unavoidable and whistleblower tools that help engage citizens directly in the integrity battle are softer tech, but nonetheless, essential tools. For example, Factico crowdsources data about public infrastructure and services in Mexico and includes a whistleblower app that allows citizens to take 30-second video clips and a Yelp-like interface for location visualization.[40]

Citizens are increasingly demanding greater transparency, and while the technological means are there, society lacks new technology-enabled standards for transparency and disclosure. Transparency Internationals' work to get governments to set goals and transparently track progress through its "anticorruptionpledgetracker.com" is to be applauded. Engagement initiatives should be encouraged at grassroots levels, where information can be simplified and social media platforms are effective. There is a corresponding need to increase the number and quality of channels for citizen feedback, allowing for complaints, comments, and, importantly, the ability to report corrupt activity anonymously and in different ways.

One example of this is iPaidaBribe, a Bangalore-based bribery reporting company, which has built a whistleblower app that targets petty bribery problem by crowd-reporting bribes.[41] AasPass is an Indian integrity grievance communication app that directly links citizens with anti-corruption authorities, and includes audit trails, as a one-stop shop to report and chase corruption grievances.[42]

8. Financial crime:
While illicit financial flows (IFFs) represent one of the most globally threatening areas

of corruption, they have also proven to be a quagmire for governments, regulators and financial institutions. Global financial crime has been estimated to result in approximately $2.1 trillion USD in criminal proceeds, or 3.6% of global GDP. This, by many accounts, is not shrinking despite billions of dollars of spend by the global financial community.[43]

The technologies and solutions reviewed through the T4I process have the ability to shine a spotlight into the dark room of financial crime. However, perhaps more than any other pain point pillar, the financial-regulatory-law enforcement ecosystem will have to come together in an unprecedented way to facilitate, permit and coordinate a more robust accelerated adoption of potential solutions.[44]

Nevertheless, there is much that can be implemented now. In particular, there are many AI-driven solutions for know your customer (KYC), anti-money laundering (AML) and counter financial terrorism (CFT). Companies like Tradle, which provides one-stop shopping for KYC functionality bridging internal and external networks using Blockchain technology, have tremendous potential in addressing IFFs.[45]

In the past, AI has been difficult to apply to unstructured data, such as emails, voice, SMS, computer logs, chats and social media. However, AI and machine learning can now be applied to achieve extraordinary benefits for detection and enforcement. For example, financial institutions face a major challenge in managing "false positives" in relation to AML: tens of thousands of alerts are manually reviewed and only a small fraction actually turn into a suspicious activity report. AI and ML increase the speed and efficiency of this process and lower costs. Furthermore, there have been significant advances in combining behavioral science and AI in relation to KYC, AML and CFT. For example, Quantexa can deliver a behavioral assessment of a potential or current customer/citizen by giving a

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[39] ArcLife, www.arclife.com

[40] Factico, www.factico.com.mx

[41] iPaidaBribe, www.janaagraha.org

[42] AasPass, www.aaspass.org

[43] UNDOC, www.unodc.org/documents/data-and-analysis/Studies/Illicit_financial_flows_2011_web.pdf

[44] Deploying Regtech Against Financial Crime, Institute of International Finance, 2017

[45] Tradle, www.tradle.io

360 degree view of all behavioral network connections, providing a credit-risk score that is used during the KYC and AML processes.[46]

The power of behavioral analytics combined with AI applied to unstructured data is demonstrated by Singapore-based Sqreem. It has built one of the world's largest data-fusion capabilities ever deployed against corruption and is the quintessential example of the power of combining big data with AI capabilities. Sqreem uses AI to find anomalies (behavioral, specific intent, internal process and structural) by first defining normalcy within a gargantuan data set, stored on a platform occupying over 10,000 servers. While its solutions are applicable to virtually every pain point in the T4I Challenge, its solutions have extraordinary relevance and implications in tackling IFFs.

Government onboarding: the path to implementing integrity solutions

There are several principles that are necessary for governments to implement game-changing integrity solutions:

- **Lead from the top:** Without the highest level of official sector leadership, these solutions will not be implemented. The demonstration of the commitment to integrity begins with a leadership commitment to implement integrity solutions and partner with the private sector.

- **When in doubt, pilot.** Regulators are having success "sand-boxing" new fintech solutions. Many of the innovative solutions coming out of T4I are being piloted (or need to be piloted) before being rolled out in scale.

- **Open APIs:** Most of the innovative companies in this space can be onboarded through APIs, which are faster, scalable, cost efficient and flexible. Companies, like Brillant Pay are building their entire service delivery strategy around providing open API gateways.[48] While most governments are not yet ready to adopt this approach, it will inevitably become mainstream. Governments that adopt open API models have the potential to implement innovative opportunities at a previously unthinkable pace.

- **"Reliable as a service":** Many of the innovative companies in the T4I Challenge are relatively small by government standards, yet they have embraced new technologies, in partnership with the likes of IBM, Mastercard, Microsoft, PWC and others. Many SMEs have accelerated the testing and adoption of cutting-edge solutions by using blockchain, AI, smart card, biometric and cloud solutions "as a service". T4I judges frequently found that Microsoft Azure or Cloud services, or IBM's Blockchain or Watson, were imbedded, or that Mastercard had run the pilot, or PWC had added an auditorial layer of reliability to a solution. All of this can provide comfort to governments as they seek to innovate.

- **Train the team:** Governments cannot design technologically advanced, solution-oriented RFPs, and review tech ideas from consultants, ICT providers and fintech innovators without the necessary competency. The allies and contributors in the T4I Challenge are committed to building capacity.

- **Utilize the expertise of the private sector:** Governments must leverage the knowledge of the private sector effectively and build a deep partnership with it.

Conclusion

The fundamental hypothesis of Tech for Integrity Part I was that technology has the potential, if applied aggressively, to radically reduce corruption. The Citi T4I Challenge only served to confirm that hypothesis. The technologies and solutions needed for the integrity war are not futuristic; they are available now. There are a plethora of companies that have the interest and capacity to successfully compete for transparent mandates to execute their integrity solutions; the enthusiasm with which they participated in the T4I Challenge was a clear demonstration.

James Wolfensohn, then president of the World Bank, called the world to action in a historic 1996 speech by urging us to "fight the cancer of corruption wherever we find it." More than 20 years later, we have the technological tools to find and fight this cancer. It is up to us to use them. The private sector strategic allies, NGOs and official contributors of the T4I Challenge, including Citi, stand ready to play a leadership role in the next stage of this effort.

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[46] Quantexa, www.quantexa.com

[47] Sqreem, sqreem.com

[48] Brillant Pay, www.brillantpay.com