Government Transparency Institute

Isabelle Adam [1] *& Mihály Fazekas* [2]

Are emerging technologies helping win the fight against corruption?

A review of the state of evidence

Working Paper series: GTI-WP/2020:02

April 2020, Budapest, Hungary

[1] Government Transparency Institute

[2] Central European University, Government Transparency Institute

Abstract

Information and Communication Technology (ICT) is often thought of as a uniformly positive tool making governments more transparent, accountable, and less corrupt. However, the evidence on it is mixed and often misunderstood. Hence, this article carries out a systematic stocktaking of ICT tools' impact on corruption, offering a nuanced and context-dependent assessment. The tools reviewed are digital public services, crowdsourcing platforms, whistleblowing tools, transparency portals, big data, distributed ledger technology, and artificial intelligence. We scrutinise evidence on ICT technologies' anticorruption effectiveness *and* misuse for corruption. Drawing on the commonalities across technologies, we find that ICT can support anti-corruption by impacting public scrutiny in numerous ways: enabling reporting on corruption, promoting transparency and accountability, facilitating citizen participation and government-citizen interactions. However, ICT can also provide new corruption opportunities through the dark web, cryptocurrencies, or the misuse of technologies such as centralised databases. The introduction of ICT tools does not automatically translate into anti-corruption outcomes; rather, impact hinges on the matching between ICT tools and the local context, including support for and skills in using technology.

1. Introduction

The rapid spread of ICT[1] and digitalisation as one of the forces shaping the 21st century gives an impression of great promise for revolutionising societal relations and public service delivery (Lindgren, Madsen, Hofmann, & Melin, 2019). In the field of anti-corruption, ICT has been widely perceived to offer new effective means for the prevention, detection and prosecution of corruption. As numerous studies assert, ICT can promote transparency, accountability and citizen participation. It can also facilitate advocacy and closer interaction of government and citizens. The most widely praised tools include websites and mobile phone applications as well as the newly emerging DLT[2], big data analysis and AI[3]. These tools serve the fight against corruption by enhancing access to public information, monitoring officials' activities, digitalising public services and enabling corruption reporting (for example, see Bertot, Jaeger, and Grimes, 2010; Davies and Fumega, 2014; Kuriyan, Bailur, Gigler, and Park, 2011; Subhajyoti, 2012).

1 Information and Communication Technology
2 Distributed Ledger Technology
3 Artificial Intelligence

However, the existence and availability of these tools does not automatically translate into their use, which crucially depends on the content provided, connectivity and the level of ICT proficiency (Torero and von Braun, 2006). Similarly, the application of ICT tools for anti-corruption needs to acknowledge the digital divide[4] between different social groups (Bimber, 2000; Gillwald, Milek, and Stork, 2010). For example, the proportion of women in Africa using the internet is 25% lower than the proportion of men (International Telecommunications Union, 2017). The success of ICT interventions against corruption hinges on their suitability for local contexts and needs, cultural backgrounds and technology experience (Helbig, Ramón Gil-García, and Ferro, 2009).

Although ICT is commonly studied as an anti-corruption instrument, it can also lead to the opposite effect when such tools are used *for* instead of *against* corruption. Emerging technologies can provide new corruption opportunities through the dark web, cryptocurrencies, or the misuse of well-intended technologies such as digital public services and central databases (Heeks, 1998; World Bank, 2014). While relevant research is more scant in this area, some studies points to the potentially adverse use of ICT for corruption: for instance, €2 million (ca. £1.8 million) disappear every year from Croatian tollbooths due to officials entering false data into the new digital information system (ReSPA, 2013). A few studies also find negative effects of ICT use, e.g. overinvestment in ICT tends to be associated with increased corruption (Charoensukmongkol and Moqbel, 2014). Such examples underline the fact that ICT is not *per se* a panacea against corruption, and it can also play into the hands of corrupt officials.

Given ambiguous and context dependent theoretical predictions and conflicting empirical evidence, it is imperative that scholars and policy makers gain a systematic and balanced assessment of the current state of evidence and evidence gaps. Our systematic review hopes to guide future research and contribute to better policies by exploring the following questions:

- What are the applications of ICT as a tool against corruption?
- What are the impacts and limitations of ICT tools?
- In what ways could ICT tools facilitate corruption?

[4] The term ‘digital divide’ refers to diverging paces of ICT adoption, leading to inequality in the power to communicate and process information digitally. This is also related to other determinants of inequality, such as income, education, gender, age, geography, and ethnicity (Hilbert, 2011).

To answer these questions, we systematically take stock of the academic and policy literature on the six most commonly discussed types of ICT-based anti-corruption interventions: i) Digital public services and e-government, ii) Crowdsourcing platforms, iii) Whistleblowing tools, iv) Transparency portals and big data, v) DLT and blockchain, and vi) AI. While these types are not mutually exclusive categories, they distinguish between different ICT-enabled tools according to their corruption impact mechanisms.

The review is structured as follows: Section 2 sets the stage by defining corruption and technology types; Section 3 outlines the frameworks for the impact of ICT-based anti-corruption interventions and reviews the literature; Section 4 includes our concluding remarks on the overall impact of ICT on corruption, and recommendations on the conditions under which ICT-based interventions contribute to the fight against corruption.

2. Methodology

In order to answer the above guiding questions, we systematically reviewed and assessed the available literature on applications of ICT tools against corruption. Similar to other systematic reviews in the field of e-governance (e.g. Mackey & Cuomo, 2020; Mergel, Gong, & Bertot, 2018), this review involved five methodological steps (Moher, Liberati, Tetzlaff, & Altman, 2009). First, we screened and collected potentially relevant studies using common search engines such as GoogleScholar and Web of Science. We applied search term combinations: names of each of the 5 ICT tools (including their variants) and corruption-related keywords such as “corruption”, “integrity”, “accountability”. Second, identified relevant studies for in depth-analysis applying complex criteria: i) whether the study assesses the corruption impact of one of the ICT tools we review; ii) whether the study is empirical (qualitative or quantitative), but also a solid theoretical framework; iii) geographical context of the study to maintain a global focus, giving particular attention to studies on less-studied developing regions. Third, we extracted key characteristics of the study such as bibliographic data, country/region focus, ICT type, research question, methodology, unit of observation, data, key findings, and policy implications. Fourth, we assessed the quality of evidence presented by each study by looking at aims, appropriateness of methodology, appropriateness of measurements used, causal analysis and consideration of counterfactuals, and robustness of findings. We only filtered out apparently low-quality papers at this stage. Finally, we carried out an in-depth appraisal and synthesis of the selected body of knowledge.

3. Conceptual framework

To provide a framework for reviewing the use of emerging technologies in the fight against corruption, we outline the definitions for corruption as well as the different types of ICT tools reviewed while also discussing the theoretical impacts mechanisms linking the two.

3.1 Understanding corruption

The concept of corruption is used to encompass diverse phenomena in many contexts which differ in the prevailing norms of good conduct. Hence, many characterisations of corruption are normatively charged and context-dependent (Johnston, 1996). One of the most commonly used definition of corruption is: “the misuse of public office for private gain” (Rose-Ackerman, 1978). This definition understands corruption within a bureaucratic context and associates corruption with bribery of public officials. The problem with this understanding is that it fails to encompass corruption in public positions with high degrees of discretion such as members of parliament (Warren, 2003). In addition, such a high-level definition, like many others, is good in generalising over a great variety of cases; however, it fails to provide much guidance about the origins, nature and interpretation of corrupt situations. Hence, we draw on a broad literature to rely on 2 dominant perspectives, both of which are relevant for understanding the interplay between ICT and corruption.

First, corruption can be understood as a principal-agent problem, with citizens usually being principals and government officials being agents that act on citizens’ behalf. The officials possess asymmetric information and political discretion on the distribution of resources, which potentially allows room for corruption. Consequently, strategies to fight corruption in the sense of the principal-agent problem commonly focus on decreasing discretionary power of government officials and establishing better oversight and accountability (Klitgaard, 1988).

Second, corruption can be understood as a collective action problem – for example, where government officials’, businesses’ and citizens’ behaviours are influenced by social norms, deterrents and the probable behaviour of others, such as whether peers also pay or accept bribes. Moreover, many societies are characterised by particularism, meaning that people’s treatment by the state depends on their position in society. Therefore, corruption in particularistic societies essentially reproduces the existing structures of inequality and uneven distribution of power (Mungiu-Pippidi, 2006). Strategies to fight this

type of corruption require a more comprehensive approach that focuses on fostering anti-corruption norms and building coalitions against corruption – for example, by providing information and educating people or creating transparency and accountability initiatives.

By implication, corruption can take many shapes, including bribery, fraud, extortion, embezzlement and nepotism (Elbahnasawy, 2014). These can happen at the elite level (grand corruption) with politicians distorting government expenditures, or at a lower level (petty or bureaucratic corruption) with street-level bureaucrats being corrupted during public service delivery (Bardhan, 2006; Charoensukmongkol and Moqbel, 2014).

Corruption commonly reduces public trust in government as it diverts funds from goods and services supposed to benefit citizens and weakens the functioning of public institutions and the rule of law (Chêne, 2014). It is also likely to discourage investment (Mauro, 1995), create economic inefficiencies and contribute to income inequality (Gupta, Davoodi, and Alonso-Terme, 1998).

3.2 ICT tool types

ICT generally facilitates the processing, transmission and display of information through digital devices. This includes radio, television, mobile phones and computers, as well as network technology – the most important one being the internet (Charoensukmongkol and Moqbel, 2014). ICT tools can be grouped in a number of ways, but we opted for a categorisation driven by the literature discussing the ICT-corruption linkage. Thus, the below list is not comprehensive, while we managed to keep the tools largely distinct from each other. 1) Digital public services are a sub-form of electronic government (e-government), that involves the use of ICT tools such as web-enabled devices or electronic data management systems to provide public services to citizens (UN Department of Economic and Social Affairs, 2014). 2) Anti-corruption crowdsourcing platforms allow citizens to publicly report corruption incidences via the internet or telephone and are primarily intended for sharing cases of petty corruption in the public sector. (Charoensukmongkol & Moqbel, 2014). 3) Whistleblowing tools are similar to crowdsourcing platforms but they are rather designed for gathering detailed reports of individual cases of grand corruption with the aim of supporting criminal prosecution. 4) Transparency portals are online platforms run by governments or NGOs that publish information on government operations. Examples include freedom of information portals or open data portals (Gandomi and Haider, 2015). 5) Distributed ledger technologies

such as blockchain represent a decentralised and synchronised database maintained by a peer-to-peer network where each user holds a copy of the data. All information is transmitted, verified and saved in permanent and secure records giving rise to cryptocurrencies, smart contracts, or file storage (Natarajan et al., 2017; Walport, 2015). 6) AI technologies, such as neural networks, are learning algorithms which infer patters and relationships from large volumes of examples in order to best achieve pre-set goals. Their ability to cheaply and quickly predict and uncover hidden relationships make them valuable in policy making and policy implementation such as directing policing effort or corruption risk red flagging (Legg and Hutter, 2007).

3.3 ICT and corruption

ICT facilitates the information flow between government and citizens, across government institutions, and among citizens. Potentially this fosters transparency, accountability and citizen participation (Chêne, 2012). ICT can aid the fight against corruption by reducing information asymmetries, automating processes, limiting public officials' discretion, reducing intermediaries and red tape (Grönlund et al., 2010), and increasing the certainty and celerity of punishment (Bhattacherjee & Shrivastava, 2018).

Conversely, ICT can also have a corruption-enhancing effect as the use of digital technologies introduces new opportunities for concealing and corrupt exchanges. ICTs may introduce new layers of complexity making the concealment of corrupt acts easier, that is increasing information asymmetries; they may also create databases and administrative systems that can be hacked or manipulated easier; moreover, as ICTs can reduce information asymmetries for those seeking details about relevant officials to bribe, bribe paying might go up and public trust nose-dive (Rothstein & Teorell, 2008). Additionally, ICTs can also enable a global web of corruption making law enforcement that is largely national focused ineffective.

As further discussed in section 5.1 (Context-sensitive policy making), the framework provided in the World Development Report (World Bank, 2016) highlights that the power of ICT to improve public services and activities by enhancing integrity, transparency and accountability, crucially varies by the type of service and activity and their amenability to improvement through ICT.

One way to distinguish the ways ICT influences corruption is to look at whether it affects the supply or demand side of information provision by governments to citizens (Kossow and Dykes, 2018). Some ICTs affect one or both the supply and demand sides of information exchanges, while there are also cases

where the effect is not related to supply or demand, rather ICTs directly affect corruption through regulating administrative behaviour such as limiting the scope of officials' discretion.

3.3.1 Impact via the supply side of information

With regards to the supply side of information from governments to society, ICT can facilitate the detection and prevention of corruption through 'downward' transparency, where government activities are made public to citizens which facilitates vertical accountability. For example, information on citizens' rights and on cases of corruption can be accessed more easily; or the digitalisation of donor-beneficiary payments can remove corruption opportunities for distributing agencies (Kshetri, 2017). In sum, as the power over information becomes decentralised, corruption becomes riskier to commit (Castells, 2000; Soper, 2007).

Nevertheless, digitalisation can also create new vulnerabilities for hacking and manipulation at a scale simply not possible in a paper-based government, or it may shift corruption to other areas of government activities that are not yet digitalised. ICT may concentrate new, system-wide corruption opportunities in the hands of those few who have the right tech skills; and increased transparency can also facilitate corruption, for example, in public procurement by enabling bidders to more effectively identify which official to bribe (Bac, 2001).

3.3.2 Impact via the demand side of information

Concerning the demand side of information from citizens, emerging technologies can foster forms of 'upward' transparency. Supervisors receive citizen feedback on public officials' performance, for example, through digitalised public service delivery. Such feedback loops create complaint channels that can lead to prevention, detection and punishment of corruption. Also, platforms for information sharing, such as news websites, crowdsourcing platforms, and social media, can foster civil mobilisation against corruption (Grönlund et al., 2010; Kossow and Dykes, 2018).

Nevertheless, false information might be spread. Online activism might give people the impression that they are active against corruption while the virtual activity does not translate into impact. Digital means of interaction among citizens and businesses may also render corruption easier to organise and maintain by lowering transaction costs and allowing for more efficient monitoring within criminal groups.

3.3.3 Impact via administrative regulations

ICTs can also directly affect corruption through regulating administrative behavior such as limiting the scope of officials' discretion through a government IT system. The digitalisation of public services automates administrative tasks and reduces direct contact points between citizens and public officials, therefore removing corruption opportunities. In addition, the increasing adoption of ICT in government operations may be accompanied by new regulations designed to restrict public officials' discretion in administrative processes. Yet, ensuring de facto compliance with de jure administrative rules is challenging throughout developed and developing countries, because rules need to allow for some discretion and because monitoring is costly (Jain, 2001). Importantly, as for example Kelman (2005) highlights, reducing public agents' discretion through ICT can have adverse consequences by also curtailing desired behaviour. Tighter rule-enforcement may impose additional compliance costs on honest officials and demotivate them. Higher risk of audit can increase risk-averse behaviour, slowing bureaucratic processes, potentially outweighing the benefits of better controls.

In sum, the reviewed literature points at both positive and negative impacts of emerging technologies on corruption, depending on a range of contextual factors and enablers. For example, in a study on the effect of ICT diffusion on corruption in Africa, Sassi & Ben Ali (2017) found that anti-corruption effects of ICT adoption only materialise once a threshold of rule of law is reached. This emphasises the importance of comprehensive reforms of law enforcement and state building (Sassi and Ben Ali, 2017). Similarly, Charoensukmongkol and Moqbel (2014) find a u-shaped relationship between ICT investment and corruption. This implies that, while increased investment in ICT can lead to reduced corruption, overinvestment in ICT tends to result in increased corruption, as the distortion of such funds through a non-transparent procurement process easily create corruption opportunities. Bhattacherjee & Shrivastava (2018) stress that ICT laws moderate the effect of ICT use on corruption, suggesting that ICT investments may have limited effect on corruption, unless complemented with appropriate ICT laws. As this illustrates, ICT's potential anti-corruption use depends on political, infrastructural, legal, social and economic factors. The risk of misuse needs to be carefully considered.

4. Assessment of individual technologies and tools

4.1 Digital public services

Digital public services are a sub-form of electronic government (e-government), that involves the use of ICT, particularly the internet, web-enabled devices, and electronic data management systems, for the provision of public services to citizens (UN Department of Economic and Social Affairs, 2014). Governments aim to improve performance by automating services and simplifying recurrent bureaucratic processes (World Bank, 2016).

Digital public services can reduce corrupt behaviours rooted in the principle-agent problem by enabling internal supervisors to monitor officials' activities more effectively. They also increase external transparency thereby impacting on the supply side of information to citizens (Pathak, Singh, Belwal, and Smith, 2007; Shim and Eom, 2008). Digital public services also reduce face-to-face contact between public officials and citizens, lowering bureaucratic discretion and removing opportunity to interact and build trust necessary for corruption; both of which are expected to reduce corruption (Charoensukmongkol and Moqbel, 2014).

Nevertheless, Barata (2001) stress that digital public services do not in themselves ensure improved transparency and accountability. E-government projects in developing countries often fail due to state failure and low capacity, as well as inappropriate designs which do not match on-the-ground realities, such as the computerisation in a national Epidemiology Service in Central Asia the design of which assumed the use of a broad range of software and hardware and IT-skilled staff, however the initial reality was manual operations using typewriters, phone, fax and post (Heeks, 2003; Schuppan, 2009). A major impediment for the widespread use of digital public services in many countries is the digital divide – that is, the inequality in public access to ICT (and basic requirements of electricity and internet connection) and the capability and motivation to use them as intended.

Instead of enhancing oversight, digital public services may introduce new opportunities for systematic misuse. They could potentially shift corruption towards remaining paper-based areas, or enable the concealment of corrupt actions by individual tech-literate officials (Pacific Council on International Policy, 2002). For instance, public administration employees in Bosnia-Herzegovina, following the introduction

of an electronic citizen registration system, misused their access and forged data to sell false ID cards and passports (ReSPA, 2013).

4.1.1 Empirical evidence

There is a diverse body of literature on the relationship between e-government and corruption, with a number of medium-quality empirical studies that lend support to the suggested effect of e-government mitigating corruption.

In a study of 127 countries, Shim and Eom (2008) find that different e-government measures account for 77% of total variation of corruption perception levels. They appear to be more influential on corruption reduction than the tested conventional anti-corruption factors, including bureaucratic professionalism and law enforcement. Similarly, Andersen (2009) finds that, in non-OECD countries, increases in e-government maturity resulted in reduced corruption levels from 1996–2006, even when controlling for GDP per capita and press freedom. His most conservative estimate is that moving from the 10th percentile to the 90th percentile of the e-government measure reduces corruption by 13%.

In a later study, Mistry and Jalal (2012) confirm that, as the use of e-government technologies increases corruption perceptions decrease, with a greater impact in developing than in developed countries. Garcia-Murillo (2013) adds telecommunications infrastructure to the equation, concluding that an increased online government presence – through e-government and telecommunications infrastructure – reduces the perception of corruption around the world. Nam (2018) confirms that e-government service maturity contributes to controlling corruption and adds national culture as an important factor that moderates the anti-corruption effect of e-government. Culture encompasses unequal power distribution and uncertainty avoidance, both of which decrease the anti-corruption effect of e-government.

A number of research papers examine the effects of specific digital public services on corruption. For example, Kleven, Knudsen, Kreiner, Pedersen, & Saez (2011) and Pomeranz et al. (2013) suggest that electronic tax reporting systems significantly reduces tax evasion. At the micro-economic level, Kim, Kim and Lee (2009) studied the development of an electronic service system in the Seoul Metropolitan Government that enables citizens to monitor the progress of their applications in 54 common procedures. The study found that corruption was reduced significantly. In a case study of Tanzania, Krolikowski (2014)

examined the use of mobile payment methods for public water bills and found that this reduced opportunities for petty corruption.

To the best of our knowledge, no quantitative studies have been published about the adverse effects of digital public on corruption. Regarding qualitative evidence, Heeks (1998) uses five case studies to argue that digitalising public service systems may have no effect, or even create new opportunities for corruption by public officials. For example, a government-owned railway firm's staff found new ways to outwit a newly introduced seat reservation software designed to combat corruption by pre-booking seats on common names and selling them privately last minute. Consequently, Heeks argues that digital public services are merely a tool that can affect symptoms of a corrupt system rather than its causes.

In Kenya, an online citizen complaints system – designed to enhance co-operation between five government bodies and one non-governmental organisation (NGO) by re-routing complaints to the appropriate body – was first hailed as a success, with 184 out of 199 cases referred in the first year. One year later, this dropped to only 12 cases, and staff reportedly perceived the new technology as an additional burden (Kossow & Dykes, 2018). Complaints emerged that the platform was sometimes not accessible or very slow, there was a high staff turnover without system knowledge being passed on, lack of feedback from partner organisations, and too little outreach (Huter, 2018). Elbahnasawy (2014) also points out that, in many countries, some e-government services may be offered online, but the full processes may still require citizens to meet with government officials in person, hence the benefits of e-government would be limited.

Similarly, the cases presented by ReSPA (2013) illustrate the ingenuity with which public officials adapt to new digital systems by circumventing them or using them for their own benefit by falsifying, illegally obtaining or destroying data. For example, officials manipulated data in a new electronic road toll system re-registering trucks as cars to keep the price margin for themselves, leading to an annual loss of €2 million (ca. £1.8 million) from Croatian tollbooths. They conclude that, while digitalising the public sector can enhance transparency, it can also enable much wider abuse than without ICT. Recognising such risks, Asogwa (2012) investigates the challenges of e-records management as a component of efficient digital public services in Africa. The research shows that the benefits of digitalisation can only be realised if appropriate infrastructures, regulations, finance and trained staff are available. Furthermore, Singh et

al. (2010) note that e-government is more likely to be effective when several factors linked to corruption mitigation are explicitly considered in the design of digital public services. This can include appropriate legal frameworks ensuring transparency, access to information, and the ability to track actions and decisions back to the individual public officers, as well as context and needs suitability, ICT access and capabilities, and cybersecurity.

In sum, the empirical findings underpin a clear statistical relationship between different measures of e-government adoption and reduced corruption. This supports the theory that digital government impacts on the supply side of information by expanding information access and accountability which raise the risk of detection. Moreover, e-government also limits bureaucratic discretion and face-to-face contacts between citizens and bureaucrats hampering corrupt exchanges. Nevertheless, as the qualitative evidence indicates, digital public services can also enhance corruption, depending on a range of factors linked to the quality of design and implementation of interventions. Further studies are needed on different kinds of digital public services to help us understand which areas are most cost effective to digitise, what types of corruption are mitigated or enabled, and in what kind of public administration context. Future research should also shed light on the enabling conditions for digital public services to impact corruption.

4.2 Crowdsourcing platforms

Anti-corruption crowdsourcing platforms allow citizens to publicly report corruption incidences via internet or telephone. In contrast to whistleblowing tools (discussed below), these platforms are primarily intended for sharing incidences of petty corruption in the public sector as experienced by citizens (Charoensukmongkol & Moqbel, 2014).

A widely used anti-corruption crowdsourcing platform is I Paid A Bribe which was first introduced in India and adopted in over 10 other countries. Users anonymously share their corruption experience, including the nature, location and value of a corrupt act, but also cases where they declined to pay a bribe or interacted with honest officials. Similar platforms have emerged around the world such as Yosoborno in Colombia, Toidihoilo in Vietnam, or Ushahidi in Kenya. Some anti-corruption crowdsourcing platforms focus on specific issues such as the Check My School project in the Philippines where citizens report on the use of public funds by schools (Kossow & Dykes, 2018).

When used extensively, crowdsourcing platforms reap the benefits of upward transparency and collective knowledge, increasing the threat of exposure which deters corruption. The data gathered paint a detailed picture of how and where corruption happens and what amounts are involved. Watchdog organisations or government authorities can follow up on this information by tightening regulations and oversight in critical areas and prosecuting corrupt public officials. For example, the state of Karnataka in India used I Paid A Bribe data to push through anti-corruption reforms in the motor vehicle department, including online applications and video monitoring (Kossow and Dykes, 2018). Crowdsourcing platforms can also raise public awareness, educating citizens about their rights and the illegality of corruption. Bundling of isolated cases demonstrates the pervasiveness of corruption and potentially fosters solidarity, connects citizens and creates an anti-corruption community capable of collective action (Mungiu-Pippidi, 2013). It can therefore enhance the demand side of information from citizens and help overcome collective action problems by strengthening anti-corruption norms among victims of corruption.

Crucially, the value of crowdsourcing platforms depends on user participation. A number of factors influence the extent of crowd association and participation in a crowdsourcing initiative: accessibility and quality of ICT infrastructure; skills and abilities of the crowd; mutual expectations and trust among individuals; perceptions of the other users; vision and strategy of the crowdsourcing initiative; and external environment in terms of governance support and socio-economic circumstances (Bott & Young, 2012; Sharma, 2010). Flaws in user access, capabilities and trust, or shortcomings in platform design and organisational and technical support, can easily result in reduced value or failure of crowdsourcing initiatives.

Additional concerns revolve around the fact that crowdsourced data are often submitted anonymously. Consequently, information is hard to verify, opening up possibilities for false allegations and complicating follow-up action. The risk of security loopholes in the protection of users' data can cause mistrust and put them at risk (Asiimwe, Wairagala, & Grönlund, 2013). Conversely, anti-corruption crowdsourcing platforms might also have the involuntary effect of actually *enabling* corruption as they provide information for people seeking to bribe officials, for example, to speed up a procedure, or to find out who can be corrupted where and at what price.

4.2.1 Empirical evidence

The evidence on crowdsourcing platforms' impact on corruption is mostly limited to indications and explanations of their success or failure in terms of participation, data generated and follow-up actions (for example, see GISWatch, 2012).

Kossow and Dykes (2018) examine the crowdsourcing platform I Paid A Bribe in India which generated large numbers of reports –162,130 reports since 2010 from more than 1,000 Indian cities with an average of 25-50 reports per day (I Paid A Bribe, 2020). For example, the Transport Commissioner in Bangalore found that his department had the highest instances of bribe-taking in the state. He consequently worked with the Janaagraha Centre, the NGO responsible for the platform, to re-engineer the process for issuing drivers' licences to reduce loopholes for rent-seeking.

Ang (2014) contrasts the success of I Paid A Bribe in India with the failure of similar initiatives in China which were plagued by internal organisational problems. These included mismanagement, opportunism to use the platform for personal vengeance, and a narrow understanding of anti-corruption as a principal-agent problem; the focus was on exposing and arresting corrupt individuals, rather than addressing structural issues. In India, such problems were comparatively absent as the Janaagraha Centre offered the autonomy and professionalism necessary to channel crowdsourced information into constructive policy engagement and public education. China's case points at the limits of crowdsourcing activism in authoritarian states, not only due to external constraints but also to weak civil society.

Asiimwe et al. (2013) provide a case study on two projects in Uganda that aim to fight public service corruption in low-resource communities by enabling citizens to report on it by phone, radio, SMS or e-mail. The track record exhibits real change achieved as the project providers and voluntary action committees verify reports on the ground and open dialogue with the relevant public service bodies. The authors find that enabling factors for this kind of reporting include efficient and effective reporting processes, convenience, direct links to service delivery outcomes, privacy and affordability. The challenges were poor infrastructure facilities, mistrust towards project officials, misuse, gender issues, and economic sustainability and finding the right scope for operations (Asiimwe et al., 2013).

In contrast to these optimistic reports, Hellström and Bocast (2013) compare a number of anti-corruption crowdsourcing platforms implemented in East Africa. They find that five out of six have such small

number of reports (less than 100) that their utility seems limited. Only the I Paid A Bribe initiative in Kenya successfully generated more than 3,500 bribe reports between 2011 and 2013. These were used by civil society organisations to argue for improved governance procedures and tighter regulation (Hellström & Bocast, 2013). However, not much is known about the initiative's impact and it ceased operations in 2015. Hellström & Bocast (2013) subsequently conducted a detailed qualitative investigation into the Ugandan anti-corruption crowdsourcing platform, Not In My Country, designed specifically for recording and publicising corruption at universities. The platform received broad support on social media and had more than 15,000 unique visitors. However, only 10 corruption reports were submitted at the time of research. They found that peripheral factors such as limited internet access, a non-intuitive website, and fears of government surveillance inhibited students to report corruption. It appeared that, while most respondents shared the long-term goal of reducing corruption and have experienced repeated incidences of corruption, they also recognised some benefits of corrupt practices such as buying exam questions in advance. They also indicated that engaging with anti-corruption initiatives that accord with local communication customs would be preferable – for example, through radio call-in shows, anti-corruption petitions, or using peers to file a report (Grönlund et al., 2010).

In sum, the evidence base for the impact of anti-corruption crowdsourcing platforms on corruption is quite thin, with a few success stories and qualitative investigations into success factors. It appears that crowdsourcing platforms can help tackle corruption when implemented well, but can have no impact too. Many platforms remain experimental and seem to have limited added value as the number of reports remain low with no documented impact. This points to the fact that crowdsourcing platforms need to be embedded in a broader initiative and it is important to consider the short-term needs and modes of action and communication for target participants. The ease of use, guarantee of anonymity, adaptation to the context, and follow-up action appear to be crucial to reap the benefits of collective knowledge and action.

4.3 Whistleblowing tools

Whistleblowing tools using ICT are similar to crowdsourcing platforms as they enable people to report wrongdoing by public officials. The difference is that whistleblowing tools are usually designed for gathering detailed reports of individual cases of grand corruption with the aim of supporting criminal prosecution. They seek lower numbers but greater depth and reliability of reports, thus impact is expected

through the demand side of information and upward transparency. Examples of ICT-enabled whistleblowing systems include: GlobaLeaks, an open-source software that can be adopted to different settings; and the BKMS® compliance system, mostly for internal whistleblowing, which encrypts and forwards reports to an internal examiner.

Whistleblowing tools provide invaluable information on corruption cases that would otherwise remain secret. The technological design of ICT-enabled whistleblowing platforms needs to ensure anonymity and protection, as the possibility of a breach of protection could strongly discourage potential whistleblowers. This includes disguising whistleblowers' IP addresses and safeguarding data transfer and establishing legal frameworks which protect anonymous whistleblowers (Salbu, 2001). At the same time, these platforms should enable follow-up communication between officials and whistleblowers. In some cases, officials try to encourage whistleblowers to reveal their identity – for example, in order to act as witnesses in a trial. The platform providers should carefully consider this option, realistically assessing the risks involved for whistleblowers (Kossow & Dykes, 2018). Another challenge is finding the right balance between broadly raising awareness and limiting the volume of reports to ensure quality and capacity for handling them promptly and professionally.

When a whistleblowing report results in prosecution and cases become publicised, it may increase the perceived risk of detection hence prevent corruption.

4.3.1 Empirical evidence

Given the unique nature of high-profile and often complex cases resulting from whistleblowing reports, there is a general paucity of evidence on effectiveness. For general insights on enabling factors for whistleblowing in the workplace environment, Zipparo (1998) conducted a survey of more than 800 public sector employees in New Zealand to investigate what deters them from reporting workplace corruption. The most common concerns were not having enough proof and the absence of legal protection. The author also found that respondents from lower-income groups were significantly more likely to be deterred from reporting corruption in the absence of encouraging factors.

With regards to the use of ICT-enabled whistleblowing platforms, Kossow and Dykes (2018) offer some qualitative insights based on interviews with key informants working on whistleblowing platforms from developing countries. One is Kenya's anonymous whistleblowing platform operational since 2005 which

records all necessary information and enables anonymous interaction with a whistleblower. The platform was embraced by the public in the first years and thousands of reports were submitted. The numbers have dropped in recent years, supposedly due to insufficient publicity (Kossow & Dykes, 2018). A similar platform in Indonesia supports the argument that publicity is an important factor to success.

In summary, ICT-enabled whistleblowing tools can facilitate reporting on cases of grand corruption with sufficient detail for follow-up legal action. This generates impact through the demand side of information and upward transparency. The protection of whistleblowers' identities, appropriate follow-up action, and publicity for the platform are crucial to their success. If security measures are not properly implemented, hacking or leaking of identity information can endanger users and deter others from reporting. If a whistleblower faces repercussions, it could greatly discourage other potential whistleblowers and thus weaken anti-corruption efforts. At the same time, platform providers need to follow up on reports, evaluate their accuracy and act – otherwise, potential whistleblowers might lack the motivation to report corruption.

If we are to understand the direct impact of upward transparency from whistleblowing platforms on corruption through scientific evidence, much more research is needed, going beyond simple statistics of use and anecdotal evidence.

4.4 Transparency portals and big data

Transparency portals are online platforms usually run by governments or NGOs that publish information on government operations. They include open data portals where government datasets are compiled and freedom of information portals which facilitate citizens' information requests (Bagozzi, Berliner & Almquist, 2019). The Argentinean Dinero y Politica presents data on political party finances, for example; OpenSpending.org provides data on government budgets by mapping money flows; or DIGIWHIST's OpenTender.eu publishes information on public contracting along with corruption risk indicators (Fazekas, Cingolani, & Tóth, 2017). Transparency portals ideally provide government information as open data, meaning that data are freely and easily accessible, machine-readable, and explicitly unrestricted in use (Gurin, 2014). Open data may be, but are not necessarily, big data – that is, very large amounts of heterogeneous and complex data, requiring special data-processing and analytical tools (Gandomi & Haider, 2015).

Transparency portals open new opportunities for citizen oversight. For example, when information on public budgeting is published, citizens can more easily hold officials to account for spending decisions (Wickberg, 2013). Transparency portals can help to tackle corruption by enhancing the supply side of information from governments to citizens which fosters downward transparency and accountability. The existence of such platforms can discourage public officials from engaging in corruption as the risk of exposure increases.

Critics argue that supply-side governmental online transparency is generally a dubious concept since it is provided by governments themselves – meaning that 'inconvenient' information may remain undisclosed or removed from public scrutiny (Suleiman, 2017). Governments might 'whitewash' themselves – for example, by joining initiatives such as the Open Government Partnership – without actually making the substantive changes that would increase transparency and accountability. Furthermore, transparency portals are only as good as the data they use, which depends on government willingness to be rigorous about data collection. If government agencies release incomplete, inaccurate, or purposeless data, the information most valued by the public could remain undisclosed. Besides, the mere existence of open government data does not ensure an impact on corruption. Limited resources and numerous logistical issues obstruct the effective use of transparency portals (Adam et al, 2020). Many countries lack key data and face gaps in technology and skills, have patchy legal frameworks, or lack access to finance for open data initiatives.

4.4.1 Empirical evidence

Empirical evidence has been ample, pointing out that often what is claimed to be open data is, in fact, not or only partially open. For example, (Brito, 2011) reviews the US government's transparency portals and finds that the data that is technically available is often not available in useful formats, for example, when documents are only uploaded as scans and so are not machine-readable and searchable. *The State of Open Government Data in 2017 report* (Lämmerhirt, Rubinstein, and Montiel, 2017) demonstrates that the challenges to open data use have remained since Brito's study. They identify the three critical obstacles preventing open data use: data is hard to find, not user-friendly, and not openly licensed. Despite an increasing number of countries providing open data, politically sensitive information and other datasets that would be key to accountability were found to be among the least likely to be

published. In many countries, crucial datasets such as company or land registers, are simply not available digitally due to the administration's lack of capacity or digitization (Open Data Barometer: Global Report Fourth Edition, 2017).

Many data portals, particularly those of local governments, appear to be misimplemented and developed with the classic website model in mind, which provides access to data only through user interaction with web forms (Correa, Souza, & Silva, 2019).

Gurin's (2014) stresses that even though the international open data movement is having an impact on government policy – about 60 countries committed to releasing government data under the Open Government Partnership – most of this activity has taken place in developed countries, while the use of open data in developing countries faces more obstacles. A report by Davies and Fumega (2014) on open data programmes across 13 developing countries finds that, although there is evidence that open data is being used in some new applications or analysis, examples of the direct use of open data and its outcomes are limited. This is due to frequent mismatch between the supply and demand of open data in developing countries.

Cuillier and Piotrowski (2009) empirically show that, as more people use the internet for gathering information about their governments and communities, they increase support for government transparency and the right to request public records. This implies that, in countries with less internet use for information-seeking, there is less demand for public access to government records. Nevertheless, Davies and Fumega (2014) highlight that transparency portals can create new spaces for civil society to pursue government accountability. Such intermediaries are vital for the successful supply and use of open data.

Srimarga's (2010) analyses the transparency portal for national budget data in the Ministry of Finance of Indonesia and suggests that the initiative allows NGOs to participate more in public decision-making as more opportunities for evidence-based advocacy arise from the improved budget transparency. Nevertheless, the NGOs criticised that the data provided are sometimes inconsistent, deficient or not provided in useful formats and so cannot be used for investigative purposes.

At the same time, the notion that greater transparency enables citizen action against corruption is brought into question. Bauhr and Grimes (2014) find that an increase in transparency in highly corrupt countries

tends to breed resignation and reduce political interest and institutional trust, rather than fostering indignation, oversight and collective action. If citizens lack institutional avenues to hold office holders accountable with the information gained through increased transparency, their civic engagement may be deterred (Bauhr & Grimes, 2014).

In summary, rigorous evidence on the impact of big and open data on transparency portals is still relatively scarce. Its effect on the supply side of information and downward transparency appears to hinge on a variety of factors connected to context, implementation, and avenues to use data-driven insights. Transparency portals are only as good as the data they provide and the engagement of an active civil society or business community to be able to use the data as effective remedies for corruption. As a result of an effectively implemented transparency portal, governments may change the documentation of public data, enabling oversight and curbing corruption. However, the mismatch between the supply and demand of data, lack of resources, weak sanctions, and weak user communities weaken such portals' anticorruption effect. Overall, we need a more nuanced and detailed understanding of how transparency portals providing open data can have an impact on corruption.

4.5 Distributed ledger technology (DLT) and blockchain

Blockchain, as one type of DLT, is a decentralised and synchronised database maintained by a peer-to-peer network where each user holds a copy of the blockchain. All information is transmitted, verified and saved in the distributed ledger as blocks that cannot be changed or deleted. Therefore, permanent and secure records are created which can be used for cryptocurrencies, smart contracts, or file storage (Natarajan, Krause, & Gradstein, 2017; Walport, 2015).

In this way, blockchain can be used to manage the supply information, offering full transparency. It could be applied by governments for storing public transactions and documents, for tracking budget spending, saving land records and company registries, or reshaping contracting and payment systems. This would mitigate some of the risks associated with central government databases that could be hacked or manipulated. Hence, using blockchain technology can increase transparency and prevent fraud, enhancing possible oversight and accountability (Kshetri, 2017).

Therefore, the application of blockchain-based technologies is carries great promises. In international development co-operation, blockchain technologies can bring about innovative ways of establishing a

direct link between donors and recipients. This can circumvent the allocation of funds to organisations or administrators where corruption could happen. For instance, a South African start-up has established a platform where donors can fund utility costs for South African schools using bitcoin. Another example is the African TruBudget platform where international donors can see ministries' spending decisions.

However, blockchain is not a panacea and without well-planned policy and a holistic, co-ordinated effort of all stakeholders, it appears unlikely to "be realized on a large scale anytime soon due to the resistance of the existing leadership and lack of infrastructure" (Kim & Kang, 2017). At the most basic level, blockchain technologies are as good as the data entered into them. Where people record transactions improperly, enter inaccurate data or deliberately falsify records, no significant positive impact can be expected. On top of that, blockchain technology may even pose a threat to anti-corruption efforts as it enables fully anonymous and encrypted cryptocurrency transactions that may be used for embezzlement or fraudulent deals. Furthermore, the complexity of DLT technologies may raise suspicion in citizens especially in countries suffering from endemic distrust in government.

4.5.1 Empirical evidence

Unfortunately, a lot of potential interventions are only being developed and piloted. In Ghana, for example, two start-ups, Bitland and Benben, aim to introduce blockchain-based land registries and real estate transactions. The Swedish and Georgian governments experiment with blockchain technology for land registries. In the Ukraine, the government plans to move its farmland registry and state property and land registers to a blockchain-based system (Huter, 2018). As examples of blockchain applications that are already mature, it is too early to assess the impact of blockchain applications as anti-corruption tools; more experimentation and innovative cases should be developed and rigorously tested. It is crucial that governments continue to turn paper-based processes into digital ones. The digital processes could later be moved to a blockchain application, if blockchain is found to add value on top of digitisation. Additional research is also needed to establish if cryptocurrencies facilitate corruption and money laundering because, unlike banking transactions, they are not subject to regulation and government oversight. While cryptocurrencies allow for highly secure payments with publicly visible transactions. The parties to the transaction, however, can remain anonymous, and the technology could be used to move, launder and protect illegitimate funds.

To sum up, blockchain technology can impact on the supply side of information as it offers increased levels of transparency and accountability to the public sector, cutting out the 'middlemen' with discretion over resources, thus reducing corruption opportunities. Nevertheless, blockchain's anticorruption impact is largely untested. It also poses a challenge to data security and regulation, and could possibly even enable the transfer of corrupt funds.

4.6 Artificial Intelligence (AI)

AI technologies, such as neural networks, are learning algorithms which infer patters and relationships from large volumes of examples in order to best achieve pre-set goals. Their ability to cheaply and quickly predict and uncover hidden relationships make them valuable in policy making and policy implementation such as directing policing effort or corruption risk red flagging (Legg and Hutter, 2007). One such neural network tool is a self-organising map that can extract patterns from large data sets and visualise them to predict corruption (López-Iturriaga and Sanz, 2017). However, such technologies are only as good as the data they are based on. They may replicate past biases and miss new developments. Criminal groups can also use AI tools to increase their own efficiency and better predict threats to their organisations and business models.

4.6.1 Empirical evidence

The literature on AI and corruption is scant, but previous research used data-mining techniques and neural networks to predict patterns in related fields such as crime (Li and Juhola, 2014), credit risk evaluation (Swiderski, Kurek and Osowski, 2012), and fraud detection (Olszewski, 2014).

One notable application for predicting corruption was developed in Spain at the University of Valladolid as an early warning system based on a neural network approach creating self-organising maps (López-Iturriaga and Sanz, 2017). The researchers used media and court data of corruption cases from the various Spanish provinces between 2000 and 2012. Their findings indicate that corruption is stimulated by the taxation of real estate, economic growth, the increase in real estate prices, the growing number of deposit institutions and non-financial firms, and the same political party remaining in power for long periods . They argue that their computer model can calculate the probability of corruption in different provinces and the conditions that favour it, providing time frames to predict corruption up to three years in advance (López-Iturriaga and Sanz, 2017).

On a broader level, a recent study by Lima & Delen (2019) employed contemporary machine-learning techniques to discover the most important predictors for Corruption Perception Indexes across 132 countries for the years of 2017 and 2018. Based on enriched/enhanced nonlinear models with a high level of predictive accuracy, the Random Forest (an ensemble-type machine learning algorithm) is found to be the most accurate prediction/classification model, followed by Support Vector Machines and Artificial Neural Networks. The variable importance results indicated that government integrity, property rights, judicial effectiveness, and education index are the most influential factors in defining the corruption level of significance (Lima & Delen, 2019b). The advancement of such machine learning techniques to predict results with the highest possible accuracy and unearthing hidden patterns of data is likely have many future uses in the fight against corruption. However, at the current state of development, and with the lack of further scientific evidence, the impact of AI on corruption is difficult to assess. Future developments should be accompanied by rigorous assessment and build on existing evidence from other areas of application.

5. Conclusions and policy lessons

ICT has affected the work of all actors involved in or against corruption, including public institutions, civil society organisations, the private sector and the media. While many see great promise in this development, the effectiveness of ICT tools, as well as their drawbacks and potential misuse, vary widely. Some technologies may enable corruption. Having taken stock of the available academic and policy literature, we have been able to shed light on the detailed characteristics of six different ICT tools used *against* as well as *for* corruption.

E-government is broadly found to be a useful tool for strengthening the supply side of information, however, depending on the design, digital public services are often not effective and can even provide new corruption opportunities – therefore, their implementation needs to be embedded in broader administrative reform. The evidence base for the impact of anti-corruption crowdsourcing platforms on corruption is quite thin, but it appears that they can foster upward transparency when implemented well (meaning easy use, guarantee of anonymity, and follow-up action), but possibly have no impact at all due to the low number of users. Similarly, ICT-enabled whistleblowing tools have limited evidence to show that they can facilitate detailed reporting on cases of grand corruption. Again, the guarantee of

anonymity and appropriate follow-up action is crucial to impact. Concerning transparency portals, impactful examples are still relatively rare and the mismatch of supply and demand of data, a lack of resources, means of sanctions, and logistical challenges commonly appear to hinder effective implementation of such portals. The newly emerging DLT/blockchain technology is anticipated to have great potential for enhancing accountability in the public sector. However, it also raises concerns about data security and, for instance, enabling untraceable flows of money. Likewise, while the application of AI technologies carries great promise, at the current state of development and with the lack of scientific evidence, the impact of AI on corruption and its potential is difficult to assess.

Drawing on the commonalities across different technologies, ICT can support anti-corruption in a variety of ways. It can enable the promotion of transparency, accountability, while also facilitating advocacy and citizen participation. It has also proven to enable a closer interaction between government and citizens – for example, by enhancing access to public information. ICT can genuinely impact public discretion and scrutiny by digitising and monitoring officials' activities and public services, and enabling corruption reporting.

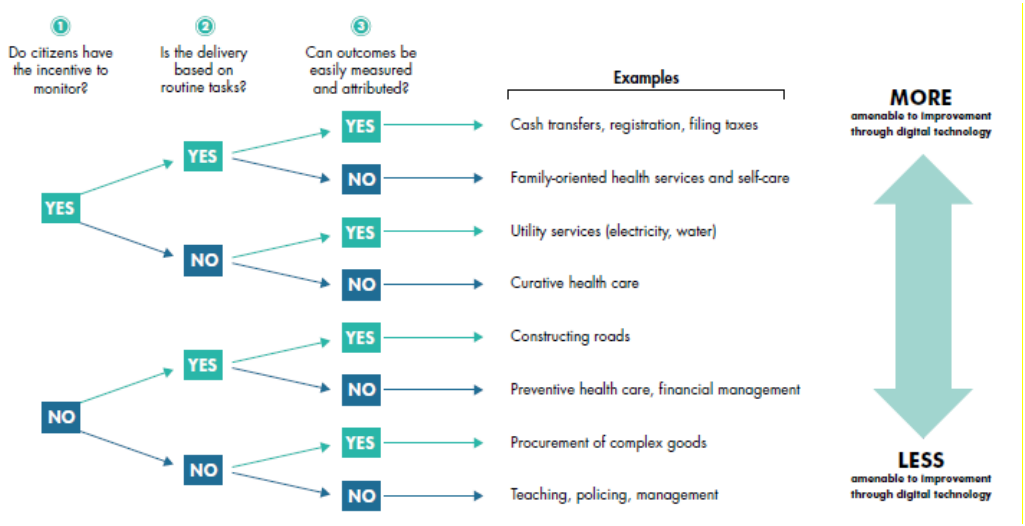
However, ICT can also facilitate corruption. Emerging technologies can provide new corruption opportunities related to the dark web, cryptocurrencies, or simply through the misuse of well-intended technologies such as digital public services. ICT can also contribute to the centralisation of corruption, for example when a corrupt group controls the central database holding all record for financial transactions in a country. These aspects underline the fact that ICT is not *per se* a panacea against corruption, and it can also play into the hands of corrupt officials. The availability of these tools does not automatically translate into their impact rather anti-corruption effects are mediated by the socio-economic context and the broader accountability framework. Specifically, the content provided needs to fit the given context. Similarly, the application of ICT tools for anti-corruption needs to acknowledge the digital divide between different social groups. Therefore, the success of ICT interventions against corruption hinges on their suitability for local contexts and needs, cultural backgrounds and technology experience.

5.1 Context-sensitive policy making

Overall, from a policy perspective, the power of ICT to improve public services and activities, e.g. by enhancing integrity, transparency and accountability, varies by the type of service and activity, based

on three factors: the degree to which citizens have the incentives and skills to monitor the service and provide feedback; the extent to which the processes for the production and delivery of the service or activity are based on tasks that can be made routine and standardized; and the measurability and extent to which the outputs and outcomes from the task can be attributed to particular public actors or actions (World Bank, 2016), as figure 1. illustrates.

FIGURE 1. CLASSIFYING PUBLIC SERVICES AND ACTIVITIES AS TO THEIR AMENABILITY TO IMPROVEMENT THROUGH ICT



Source: World Bank (2016) World Development Report, p. 180.

First, a favourable public governance area to target with ICT should be characterised by a demand for information and motivation from citizens to use them, e.g. for public goods or services that they use frequently such as registration services or tax filing, thus they care about the activities in question. Else, transparency without users does not lead to accountability and improved public governance. In addition to having an incentive to monitor their governance, citizens also need to have the knowledge and skills to interpret information provided; and the use of many ICT tools requires connectivity and a certain level of ICT proficiency which cannot be taken for granted in many countries (not included in the graph).

Second, the application of ICT tools for improving public governance needs to carefully consider whether the tasks that will be affected (e.g. by becoming digitised or automated) are routine tasks that are more amenable to improvement through digital technology than exceptional or highly discretionary tasks, on which policy makers have less influence over the providers responsible. Such tasks are much more dependent on the quality of existing institutions and improvements through the application of ICT are only incremental.

Third, governance areas that are measurable and attributable to the efforts of specific government officials is likely much more amenable to improve with the use of ICT. When citizens can assess the service improvement and can attribute this improvement to actions by policy makers and providers. The quick, easily visible, and easily attributable service improvements to citizens can yield political benefits that even clientelist politicians might have an interest in supporting, though the political economy considerations vary by activity.

More generally, the variation in the nature of the governance areas amenable by ICT to improve transparency, accountability, and integrity, calls for careful consideration yet opens reform possibilities and can be a guide for policies in different country contexts.

References

1. Adam, I., Fazekas, M. & Tóth, B. (2020). Measuring the benefits of open contracting: Case studies on Mexico, Paraguay, and Slovakia. GTI-WP/2020:01, Budapest: Government Transparency Institute.
2. Andersen, T. B. (2009). E-Government as an anti-corruption strategy. *Information Economics and Policy*, *21*(3), 201–210. https://doi.org/10.1016/J.INFOECOPOL.2008.11.003
3. Ang, Y. Y. (2014). Authoritarian Restraints on Online Activism Revisited: Why "I-Paid-A-Bribe" Worked in India but Failed in China. *Comparative Politics*, *47*(1), 21–40. https://doi.org/10.5129/001041514813623100
4. Asiimwe, E. N., Wairagala, W., & Grönlund, Å. (2013). *Using Technology for Enhancing Transparency and Accountability in Low Resource Communities: Experiences from Uganda*.
5. Asogwa, B. E. (2012). The challenge of managing electronic records in developing countries. *Records Management Journal*, *22*(3), 198–211. https://doi.org/10.1108/09565691211283156
6. Bac, M. (2001). Corruption, Connections and Transparency: Does a Better Screen Imply a Better Scene? *Public Choice*, *107*(1/2), 87–96. https://doi.org/10.1023/A:1010349907813
7. Bagozzi, B.E., Berliner, D. and Almquist, Z.W. (2019), When does open government shut? Predicting government responses to citizen information requests. Regulation & Governance. doi:10.1111/rego.12282
8. Bardhan, P. (2006). The Economist's Approach to the Problem of Corruption. https://doi.org/10.1016/j.worlddev.2005.03.011
9. Bauhr, M., & Grimes, M. (2014). Indignation or Resignation: The Implications of Transparency for Societal Accountability. *Governance*, *27*(2), 291–320. https://doi.org/10.1111/gove.12033
10. Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2010). Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. *Government Information Quarterly*, *27*(3), 264–271. https://doi.org/10.1016/j.giq.2010.03.001
11. Bhattacherjee, A., & Shrivastava, U. (2018). The effects of ICT use and ICT Laws on corruption: A general deterrence theory perspective. *Government Information Quarterly*, *35*(4), 703–712. https://doi.org/10.1016/j.giq.2018.07.006
12. Bimber, B. (2000). *Measuring the Gender Gap on the Internet*. *Social Science Quarterly* (Vol. 81).
13. Bott, M., & Young, G. (2012). The role of crowdsourcing for better governance in fragile state contexts. *Praxis*, *27*, 47–70.
14. Brito, J. (2011). Hack, Mash & Peer: Crowdsourcing Government Transparency. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1023485

15. Castells, M. (2000). Materials for an exploratory theory of the network society. *The British Journal of Sociology*, *51*(1), 5–24. https://doi.org/10.1111/j.1468-4446.2000.00005.x
16. Charoensukmongkol, P., & Moqbel, M. (2014). Does Investment in ICT Curb or Create More Corruption? A Cross-Country Analysis. *Public Organization Review*, *14*(1), 51–63.
17. Chêne, M. (2012). *Use of Mobile Phones to Detect and Deter Corruption*.
18. Chêne, M. (2014). *The Impact Of Corruption On Growth And Inequality*.
19. Correa, A. S., Souza, R. M. de, & Silva, F. S. C. da. (2019). Towards an automated method to assess data portals in the deep web. *Government Information Quarterly*, (November 2018), 1–15.
20. Cuillier, D., & Piotrowski, S. J. (2009). Internet information-seeking and its relation to support for access to government records. *Government Information Quarterly*, *26*(3), 441–449.
21. Davies, T., & Fumega, S. (2014). *Mixed incentives: Adopting ICT innovations for transparency, accountability, and anti-corruption*.
22. Dekker, R., & Bekkers, V. (2015). The contingency of governments' responsiveness to the virtual public sphere: A systematic literature review and meta-synthesis. Government Information Quarterly, 32(4), 496–505. https://doi.org/10.1016/j.giq.2015.09.007
23. Elbahnasawy, N. G. (2014). E-Government, Internet Adoption, and Corruption: An Empirical Investigation. *World Development*, *57*, 114–126.
24. Fazekas, M., Cingolani, L., & Tóth, B. (2017). A Comprehensive Review of Objective Corruption Proxies in Public Procurement: Risky Actors, Transactions, and Vehicles of Rent Extraction. *SSRN Electronic Journal*, (May). https://doi.org/10.2139/ssrn.2891017
25. Gandomi, A., & Haider, M. (2015). Beyond the hype: Big data concepts, methods, and analytics. *International Journal of Information Management*, *35*, 137–144.
26. Gillwald, A., Milek, A., & Stork, C. (2010). *Towards Evidence-based ICT Policy and Regulation: Gender Assessment of ICT Access and Usage in Africa*.
27. GISWatch. (2012). *Global InformatIon Soclety Watch 2012*.
28. Grönlund, Å., Heacock, R., Sasaki, D., Hellström, J., Al-Saqaf Editor, W., Strand, C., … Berggren, D. (2010). Increasing transparency and fighting corruption through ICT empowering people and communities-The Swedish Program for ICT in Developing Regions.
29. Gupta, S., Davoodi, H., & Alonso-Terme, R. (1998). *Does Corruption Affect Income Inequality and Poverty?*
30. Gurin, J. (2014). Open Governments, Open Data: A New Lever for Transparency, Citizen Engagement, and Economic Growth. *SAIS Review of International Affairs*, *34*(1), 71–82.
31. Heeks, R. (1998). *Information Systems for Public Sector Management*.
32. Heeks, R. (2003). *Most e-Government-for-Development Projects Fail How Can Risks be*

Reduced?

33. Helbig, N., Ramón Gil-García, J., & Ferro, E. (2009). Understanding the complexity of electronic government: Implications from the digital divide literature. *Government Information Quarterly*, *26*(1), 89–97. https://doi.org/10.1016/j.giq.2008.05.004
34. Hellström, J., & Bocast, B. (2013). *Many "Likers" Do Not Constitute A Crowd: The Case Of Uganda's Not In My Country*.
35. Hilbert, M. (2011). Digital gender divide or technologically empowered women in developing countries? A typical case of lies, damned lies, and statistics. *Women's Studies International Forum*, *34*(6), 479–489. https://doi.org/10.1016/j.wsif.2011.07.001
36. Huter, M. (2018). *Compliance and Digitalisation: How technology can foster transparency in African countries*.
37. I Paid A Bribe. (2020). I Paid A Bribe: Bribe-trends. Accessed on the 20/2/2020
38. International Telecommunications Union. (2017). *ICT Facts and Figures 2017*.
39. Jain, A. K. (2001). Corruption: A Review. *Journal of Economic Surveys*, *15*(1), 71–121. https://doi.org/10.1111/1467-6419.00133
40. Johnston, M. (1996). The search for definitions: The vitality of politics and the issue of corruption. *International Social Science Journal*, *48*(149), 321–335. https://doi.org/10.1111/1468-2451.00035
41. Kelman, S. (2005). *Unleashing change: A study in organizational renewal in government*. Brookings Institution Press. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.473.3731
42. Kim, K., & Kang, T. (2017). Does Technology Against Corruption Always Lead to Benefit? The Potential Risks and Challenges of the Blockchain Technology.
43. Kleven, H. J., Knudsen, M. B., Kreiner, C. T., Pedersen, S., & Saez, E. (2011). Unwilling Or Unable To Cheat? Evidence From A Tax Audit Experiment In Denmark. *Econometrica*, *79*(3), 651–692. https://doi.org/10.3982/ECTA9113
44. Klitgaard, R. E. (1988). *Controlling corruption*. University of California Press.
45. Kossow, N., & Dykes, V. (2018). Embracing Digitalisation: How to use ICT to strengthen Anti-Corruption. *Giz*.
46. Kshetri, N. (2017). Will blockchain emerge as a tool to break the poverty chain in the Global South? *Third World Quarterly*, *38*(8), 1710–1732. https://doi.org/10.1080/01436597.2017.1298438
47. Kuriyan, R., Bailur, S., Gigler, B.-S., & Park, K. R. (2011). Technologies for transparency and accountability. *Implications for ICT Policy and Implementation*, 1–67. https://doi.org/10.13140/RG.2.2.19320.24320

48. Lämmerhirt, D., Rubinstein, M., & Montiel, O. (2017). *The State of Open Government Data in 2017 The State of Open Government Data in 2017 Creating meaningful open data through multi-stakeholder dialogue*.
49. Li, X., & Juhola, M. (2014). Country crime analysis using the self-organizing map, with special regard to demographic factors. *AI & SOCIETY*, *29*(1), 53–68. https://doi.org/10.1007/s00146-013-0441-7
50. Lima, M. S. M., & Delen, D. (2019a). Predicting and explaining corruption across countries: A machine learning approach. *Government Information Quarterly*, (September), 101407. https://doi.org/10.1016/j.giq.2019.101407
51. Mackey, T.K. & Cuomo, R.E. (2020). An interdisciplinary review of digital technologies to facilitate anti-corruption, transparency and accountability in medicines procurement. *Global Health Action, 13*(1). https://doi.org/10.1080/16549716.2019.1695241
52. Lindgren, I., Madsen, C. Ø., Hofmann, S., & Melin, U. (2019). Close encounters of the digital kind: A research agenda for the digitalization of public services. *Government Information Quarterly*, *36*(3), 427–436. https://doi.org/10.1016/j.giq.2019.03.002
53. López-Iturriaga, F. J., & Sanz, I. P. (2017). Predicting Public Corruption with Neural Networks: An Analysis of Spanish Provinces. *Social Indicators Research*. https://doi.org/10.1007/s11205-017-1802-2
54. Mauro, P. (1995). Corruption and Growth. *The Quarterly Journal of Economics*, *110*(3), 681–712.
55. Mergel, I., Gong, Y., & Bertot, J. (2018, April 1). Agile government: Systematic literature review and future research. *Government Information Quarterly, Vol. 35*, pp. 291–298. https://doi.org/10.1016/j.giq.2018.04.003
56. Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Medicine, 6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097
57. Mistry, J. J., & Jalal, A. (2012). An Empirical Analysis of the Relationship between e-government and Corruption. *The International Journal of Digital Accounting Research*, *12*, 145–176. https://doi.org/10.4192/1577-8517-v12_6
58. Mungiu-Pippidi, A. (2006). Corruption: Diagnosis and Treatment. *Journal of Democracy*, *17*(3), 86–99.
59. Mungiu-Pippidi, Alina. (2013). Controlling Corruption Through Collective Action. Journal of Democracy. 24. 101-115. 10.1353/jod.2013.0020.
60. Nam, T. (2018). Examining the anti-corruption effect of e-government and the moderating effect of national culture: A cross-country study. *Government Information Quarterly*, *35*(2), 273–282.

https://doi.org/10.1016/j.giq.2018.01.005

61. Natarajan, H., Krause, S., & Gradstein, H. (2017). *Distributed Ledger Technology (DLT) and Blockchain Acknowledgments III*.
62. Olszewski, D. (2014). Fraud detection using self-organizing map visualizing the user profiles. *Knowledge-Based Systems*, *70*, 324–334. https://doi.org/10.1016/J.KNOSYS.2014.07.008
63. *Open Data Barometer: Global Report Fourth Edition*. (2017).
64. Pacific Council on International Policy. (2002). *Roadmap for E-government in the Developing World 10 Questions E-Government Leaders Should Ask Themselves*.
65. Pathak, R. D., Singh, G., Belwal, R., & Smith, R. F. I. (2007). E-governance and Corruption-developments and Issues in Ethiopia. *Public Organization Review*, *7*(3), 195–208. https://doi.org/10.1007/s11115-007-0031-6
66. Pomeranz, D., Alesina, A., Asher, S., Casaburi, L., Chetty, R., Cutler, D., … Zajonc, T. (2013). *No Taxation without Information: Deterrence and Self-Enforcement in the Value Added Tax*
67. ReSPA. (2013). Abuse of Information Technology (IT) for Corruption.
68. Rothstein, B., & Torsello, D. (2014). Bribery in Preindustrial Cultures: Understanding the Universalism-Particularism Puzzle. *Journal of Anthorpological Research*, *70*(2).
69. Salbu, S. R. (2001). Information technology in the war against international bribery and corruption: The next frontier of institutional reform. *Harvard Journal on Legislation*, *38*(1), 67–101.
70. Sassi, S., & Ben Ali, M. S. (2017). Corruption in Africa: What role does ICT diffusion play. *Telecommunications Policy*, *41*(7–8), 662–669. https://doi.org/10.1016/j.telpol.2017.05.002
71. Schuppan, T. (2009). E-Government in developing countries: Experiences from sub-Saharan Africa. *Government Information Quarterly*, *26*(1), 118–127.
72. Sharma, A. (2010). *Crowdsourcing Critical Success Factor Model*.
73. Shim, D. C., & Eom, T. H. (2008). E-Government and anti-corruption: Empirical analysis of international data. *International Journal of Public Administration*, *31*(3), 298–316. https://doi.org/10.1080/01900690701590553
74. Soper, D. (2007). *ICT Investment Impacts on Future Levels of Democracy, Corruption, and E-Government: Acceptance in Emerging Countries Recommended Citation Soper, Daniel, "ICT Investment Impacts on Future Levels of Democracy, Corruption, and E-Government Acceptance in* (Vol. 227).
75. Srimarga, I. C. (2010). *Open Data Initiative of Ministry of Finance on National Budget Transparency in Indonesia*.
76. Subhajyoti, R. (2012). Reinforcing accountability in public services: An ICT enabled framework. *Transforming Government: People, Process and Policy*, *6*(2), 135–148.

https://doi.org/10.1108/17506161211246890

77. Suleiman, M. M. (2017). *A Review of Improving Good Governance through ICT Revitalization*.
78. Swiderski, B., Kurek, J., & Osowski, S. (2012). Multistage classification by using logistic regression and neural networks for assessment of financial condition of company. *Decision Support Systems*, *52*(2), 539–547. https://doi.org/10.1016/J.DSS.2011.10.018
79. Torero, M., & von Braun, J. (2006). Information and communication technologies for development and poverty reduction: The potential of telecommunications. *IFPRI Books*.
80. Tursunbayeva, A., Franco, M., & Pagliari, C. (2017, April 1). Use of social media for e-Government in the public health sector: A systematic review of published studies. Government Information Quarterly, Vol. 34, pp. 270–282. https://doi.org/10.1016/j.giq.2017.04.001
81. UN Department of Economic and Social Affairs. (2014). *United Nations E-Government Survey 2014: E-Government For The Future We Want*.
82. Walport, M. (2015). *Distributed Ledger Technology: beyond block chain*.
83. Wickberg, S. (2013). Technological innovatins to identify and reduce corruption.
84. World Bank. (2014). *Report on the Session Digital Records Management: Good Practices for Anti-Corruption Authorities 3rd Biennial Meeting of the World Bank's International Corruption Hunters' Alliance*.
85. World Bank. (2016). *2016. World Development Report 2016: Digital Dividends*. Washington DC. https://doi.org/10.1596/978-1-4648-0671-1
86. Zipparo, L. (2001). Factors which deter public officials from reporting corruption, 273–287.