Original Article

Digital Anti-Corruption Typology for Public Sector

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ABSTRACT

Many digital anti-corruption tools have not performed well in practice due to their non-alignment with forms of corruption they are supposed to fight against, the persistence of corruption-enabling conditions, activities, and procedures where it occurs, public sector areas where it occurs, anti-corruption principles and conceptual aspects of corruption. This paper aims to fill this gap with an alternative typology of digital anti-corruption in the public sector that helps to decide what digital measures to apply to fight against specific forms of corruption or address specific corruption-enabling conditions within given areas, activities and procedures in the public sector. The main objective of this paper was to highlight anti-corruption typologies and propose an alternative typology for digital anti-corruption. The proposed typology integrates theoretical constructs from the typology of anti-corruption policies and the TASP framework augmented with digital technologies. It includes six main components: categories of digital technologies, forms of corruption, activities and procedures, public sector areas, anti-corruption principles, and conceptual aspects of corruption. The study developed a typology by adhering to the "good" typology blueprint, which involves limiting the scope, defining concepts, and synthesising findings. By scoping review methods, the study identified various digital anti-corruption technologies relevant to the public sector's corruption and anti-corruption measures. The paper contributes to existing anti-corruption typologies by proposing a multi-dimensional typology focusing on digital anti-corruption that enhances anti-corruption measures. The typology prescribes effective digital anti-corruption solutions for different corruption scenarios like job appointment and promotion based on connections and inflating public payroll with names of non-existent workers. The typology will provide policymakers, adopters of technical solutions and managers of adopting organisations with information to improve the development, design, adoption, and use of digital anti-corruption in the public sector. The

typology is grounded in research and policy literature and validated using real-life examples.

INTRODUCTION

Transparency International defines corruption as the abuse of public power for private gain (Parveen, Amuda & Hassan, 2017). Corruption can be grand or petty, depending on the amount of money lost (Parveen et al., 2017). Grand corruption is the abuse of high-level power that benefits the few at the expense of the many and causes serious and widespread harm to individuals and society, and pervades the highest levels of government (Bolanle, 2017). While petty corruption is corruption at the implementation end of public administration, involving the payment of comparatively small amounts of money to facilitate official transactions (Parveen et al., 2017).

The reviewed literature on the effects of public sector corruption shows that corruption retards economic growth, brings government waste and resource misuse, results in structural malfunctions of governments and deteriorates civil service management and public service capacity (Moldogaziev & Liu, 2020).

Also, literature on the consequences of corruption shows that public sector corruption decreases the efficiency, effectiveness, and equitability of service provision (Moldogaziev & Liu, 2020).

Given these effects of corruption in the public sector, several anti-corruption measures are in place and among them is digital anti-corruption. Digital technology is used for the prevention, detection, and prosecution of corruption in the public sector (Adam & Fazekas, 2018). Research shows that digital technology can promote transparency, accountability and citizen participation and facilitate advocacy and closer interaction between government and citizens to fight corruption in the public sector (Adam et al., 2018). Digital technology supports this process through the use of mobile channels for reporting, automated audits of transaction records to uncover fraudulent payments, or service automation to replace discretionary decision-making by public officials with rule-based automated decision-making (Adam et al., 2018; Davies & Fumega, 2014). The commonly used digital anti-corruption tools are websites, mobile phone applications and emerging DLT, big data analysis or AI (Adam et al., 2018).

However, many such tools have not performed well in practice due to their non-alignment with forms of corruption they are supposed to fight against, corruption-enabling conditions, activities, and procedures where corruption occurs, public sector areas where corruption occurs, anti-corruption principles and conceptual aspects of corruption (Lemaire 2011). Furthermore, the performance of

digital anti-corruption tools is also affected by the limitations of existing anti-corruption typologies (Villeneuve, Mugelli & Heide, 2017). Even though various typologies of anti-corruption measures have been developed, most of them do not include digital technologies, and those that include digital technology do not focus on public sector corruption. For instance, McCusker (2006) classifies corruption prevention and strategies based on three different levels of interventionism, managerialism, and organisational integrity, which do not include digital technology support. Okewu and Okewu's (2015) typology of technology-based corruption management does not focus on public sector corruption.

Given these limitations, this paper aims to guide the creation of effective digital anti-corruption in the public sector. This guidance is offered in the form of a comprehensive typology of digital anti-corruption that can be used to support different classifications of corruption in the public sector. The typology aligns specific forms of corruption or corruption-enabling conditions within given areas, activities, and procedures in the public sector to appropriate digital technology and addresses limitations of existing typologies. It highlights that digital technology can aid the fight against corruption, e.g., mobile channels to report incidents of corruption, automated audits of transaction records to uncover fraudulent payments, or service automation to replace discretionary decision-making by public officials with rule-based automated decision-making.

To develop this typology, we reviewed the literature on corruption typologies using scoping review methods and then the typology was created following the blueprint for building 'good' typologies by (O'Raghallaigh, Sammon, & Murphy, 2010).

The proposed typology may serve as a potential source of information to guide stakeholders such as policymakers, adopters of technical solutions and managers involved in fighting public sector corruption on selecting appropriate digital technologies for different corruption scenarios.

Background

Many tools, strategies and methods are used in the public sector to fight corruption and improve service delivery; however, there is a lot of evidence that corruption is still a big problem in many countries, especially developing ones (Parveen et al., 2017). For example, corruption in the public sector of the three East African countries – Uganda, Kenya, and Tanzania remain endemic regardless of the anti-corruption laws and institutions put in place (AfriMAP, 2016). Globally, the three countries rank among the most corrupt countries. In 2015, Uganda and Kenya shared the position of 139 out of 168 countries and Tanzania was ranked at position 119 out of 175 countries (Transparency International, 2015).

Proponents of using Information and Communication Technology (ICTs) in enhancing service delivery consider ICTs to have a big potential to eliminate conditions that favour corruption (Basu, 2004; Gaventa & McGee, 2013; Bhatnagar, 2014; Okewu et al., 2015). Consequently, a lot of efforts have been invested in developing ICT-based anti-corruption measures in different countries as a means of minimising corruption by increasing access to information (Lodge & Stirton, 2001). Although there has been considerable success, there have also been several failed attempts to use ICTs in fighting public sector corruption (Heeks, 2003; Heeks & Mathisen, 2012; Nawi et al., 2011). Examples of failed attempts include the computer-aided Administration of Registration Department (CARD), a registration system in the state of Andhra Pradesh (Prakash & De', 2007); Pancha Tantra online in Karnataka, India (Bhatnagar, 2014); and "Not in My Country" (NIMC) project, in Ugandan universities (Hellström & Bocast, 2013).

Technology access is one of the main barriers to using mainstream computer-based ICTs in fighting

public sector corruption (Bertot, Jaeger & Grimes, 2010). However, given the substantial growth in the use of digital and mobile technologies (Bertot et al., 2010), several researchers discern the potential of such technologies for promoting good governance, transparency, and accountability (McGee & Carlitz, 2013; Kalemera, Nalwoga, & Wakabi, 2012; Hellström, 2008; Hellström & Karefelt, 2012; Susanto & Goodwin, 2010; Wasserman, 2011; Olorunnisola & Martin, 2013). As a way of harnessing this potential, several countries have embarked on digital anti-corruption initiatives. The initiatives are part of the digital government effort to transform public administration and its relationships with citizens through digital technology to empower citizens to create public value by themselves and to achieve sustainable development outcomes in the process (Janowski, Estevez, & Baguma, 2018).

Examples of such initiatives include the Online Procedure Enhancement (OPEN) system for civil applications of the Seoul Metropolitan Government (Iqbal & Seo, 2008) and the Seoul e-Procurement System (GePS) (Iqbal & Seo, 2008). The commonly used digital tools and systems in Uganda are mobile Tracking (mTrac), AKVO flow, Bespoke & Open Data Kit (ODK) (Mutungi, Baguma & Janowski, 2019). However, many such tools also have not performed well in practice due to their non-alignment with the forms of corruption they are supposed to fight against and persistence of corruption-enabling conditions (Grönlund, 2010; Davies & Fumega, 2014) and the limitations of existing anti-corruption typologies.

Most anti-corruption corruption typologies identified in literature lack the digital technology component. The existing typologies mainly focused on one or two specific corruption features and anti-corruption strategies, leaving behind other relevant elements like digital technology support (Villeneuve et al., 2017). For example, the classification by Okewu et al. (2015) focuses on components of e-democracy to provide a typology

of technology-based corruption management which promotes government of the people (e-Government), government by the people (e-Governance) and government for the people (e-Administration). However, other aspects of ICTs' application against public sector corruption are not catered for.

Villeneuve et al. (2020) developed a typology centred on six elements for informing a comprehensive typology of anti-corruption policies. The elements are the nature of administrative corruption; the conceptual aspect; the function of anti-corruption efforts; the nature of policy, and the type of implementing body. However, this typology does not cover the digital anti-corruption element that is the focus of this study.

Other corruption typologies reviewed in the literature include a framework for the analysis of corruption which identifies types, activities, sectors, and places of corruption (TASP). Types of corrupt behaviours in the public sector include bribery, extortion, cronyism, misuse of information, and abuse of discretion (Graycar, 2015). Identified behaviours happen while carrying out different activities such as appointing personnel of procuring services in different public sectors areas like health, education, and security (Graycar, 2015). Finally, these activities are carried out in different places such as rural or urban areas (Graycar, 2015). These concepts offer a framework for the classification of corrupt events in the public sector and can therefore guide the development of an anti-corruption typology.

Weber's typology of corruption was based on subjective intentions that have or expect the individuals such as gaining power and influence, economic and business success, self-enrichment, social motives, and opportunism (Weber, 1964). A typology of corruption is based on actor categories-Petty vs. grand corruption (Pedersen & Johannsen, 2008). Other common corruption typologies are in terms of their origin, motive, magnitude,

pervasiveness, usage of resources, and direction (Habtemichael, 2009).

Apart from the TASP framework classification, which focuses on four features of corruption (types, activities, sectors, and places) and typology of anti-corruption policies with six elements, other reviewed typologies focus only on one main feature of corruption for classifying. Unfortunately, none of these features is ICT related. Therefore, there is still a need to combine the categories of the various classifications and integrate them with digital technology elements to obtain a comprehensive digital anti-corruption typology. This study responded to this need by integrating theoretical constructs from the typology of anti-corruption policies with those of the TASP framework augmented with digital technologies to create a digital anti-corruption typology. The identified theoretical constructs for the proposed typology are categories of digital technologies, forms of corruption, activities and procedures, public sector areas, anti-corruption principles and conceptual aspects of corruption.

METHODOLOGY

The main objective of this paper was to highlight anti-corruption typologies and propose an alternative typology for digital anti-corruption. Digital anti-corruption typology links digital tools to the different classifications of corruption in the public sector. Typology development followed the blueprint for building "good" typologies (O'Raghallaigh, Sammon & Murphy, 2010).

Typology Development

To develop this typology, the following steps were followed as guided by O'Raghallaigh et al. (2010):

Step 1: Limit the Domain of the Typology

Step one aimed to establish the boundaries of the typology by identifying what to include and exclude. In the case of this typology, the domain was limited to digital anti-corruption tools used in

the public sector only. This was an important decision as it helped to ensure that the typology was focused and specific to the context in which it would be applied.

Step 2: Identify and Define Concepts/Constructs

This step aimed to identify and define the key concepts and constructs that were included in the typology. These are the building blocks of the typology and provide the basis for categorising and organising the different elements. In the case of this typology, the identified concepts/constructs included digital anti-corruption technologies, forms of corruption, activities and procedures, public sector areas, anti-corruption principles, and conceptual aspects of corruption. These concepts were defined in detail to ensure that they were clear and precise.

Step 3: Synthesising Findings

Step three aimed to synthesise the findings from the previous steps to develop the typology. This involved categorising the different digital tools and different classifications of corruption in the public sector. The key was to ensure that the categories were logical, meaningful, and comprehensive.

Scoping Review Methods

The study adopted scoping review methods. The scoping review method aims at rapidly mapping the key concepts underpinning a research area and the main sources and types of evidence available (Arksey & Malley, 2005). The review mainly focused on corruption and anti-corruption measures in the public sector.

According to the five stages of the scoping review methods, the adopted methodology entails the following;

- **Identifying the research question:** The research question is: What is the typology for digital anti-corruption that is used to improve anti-corruption performance in the public

sector?

- **Identifying relevant studies:** The search for relevant studies was conducted in electronic research databases like Scopus, Academic Premier and ERIC, policy and legal publications by relevant organisations, and reference lists. The search applied combinations of the terms like "corruption", "anti-corruption", "measures", "public sector", etc., mostly published within the last 10 years.

- **Study Selection:** The references were imported into the Mendeley tool for easy referencing. Priority was given to the articles with abstracts referencing forms of corruption, conditions that enable corruption, anti-corruption measures, and digital anti-corruption technologies used to fight corruption. The literature search resulted in 895 abstracts. Out of these, only 557 relevant full-text papers were accessed due to limitations of time and cost. Again, 99 were excluded for not being directly related to any of the search criteria; forms of corruption, conditions that enable corruption, anti-corruption measures and digital anti-corruption technologies. Finally, 458 papers were included. Of these 458 papers, 199 were papers that described forms of corruption, 26 described conditions that enable corruption and 58 were for general anti-corruption measures, 8 were methodology papers, and 167 were digital anti-corruption technologies papers.

- **Charting the Data:** To keep within the desired scope, the following attributes were used for identified studies: authors, publication years, study locations, study types and methodologies, problems addressed, technologies used, and the purpose of the interventions.

- **Collating, summarising, and reporting the results:** The findings were organised according to digital anti-corruption technologies used forms of corruption, activities, and procedures where corruption takes place, public sector

areas, anti-corruption principles and conceptual aspects of corruption.

STUDY FINDINGS

Development of Digital Anti-Corruption Typology: Scope of Digital Anti-Corruption Typology Domain

Public sector corruption is the use of public resources for private gain (Moldogaziev & Liu, 2020), while digital anti-corruption refers to a family of digital tools used to fight corruption. The typology identifies types of digital anti-corruption tools that can decide what digital measures to apply against specific forms of corruption or address specific corruption-enabling conditions within given areas, activities, and procedures in the public sector.

Identification and Definition of Digital Anti-Corruption Tools

This section defines the existing digital anti-corruption tools used in the public sector. The digital anti-corruption tools are as follows:

Digital Anti-Corruption for Gathering Information

Within this category, digital technology gathers data to enhance upward transparency in public service delivery (Holeman, Cookson & Pagliari, 2016; Okewu et al., 2015). The information on service delivery performance, like stockouts, worker absenteeism, and bribery is collected. The commonly used technologies include SMS free 'Please Call Me' messages, Interactive Voice Response services, or ordinary telephone hotlines (Holeman et al., 2016; Okewu et al., 2015). A good example is Kenya's integrated public complaints referral mechanism, a joint effort between five government agencies and one NGO to develop a more efficient process for handling citizen complaints regarding corruption (Bariyo & Ngoboka, n.d.; Joshi, 2013). Other examples include the "Not in My Country" project, a

crowdsourcing platform used to record, report, and publicise corruption in Ugandan Universities (Hellström & Bocast, 2013), and IPaidABribe, Corruption Tracker and Hatari in Kenya that provides provide means for citizens to anonymously submit reports of bribery and irregularities in the public sector (Bertot, Jaeger & Grimes, 2010).

Digital Anti-Corruption for Data Aggregation and Visualization

This family of technologies is used to summarise, analyse and present information to the public for downward transparency. For example, analytics dashboards for summarising and displaying data on government practices and crowdsourced data and interactive digital mapping of independent reports are under this classification (Kossow & Dykes, 2018; Holeman et al., 2016). The open-source Ushahidi platform in Kenya which enables registered users to process reports and upload them to a digital map for online visualisation is a typical example of an analytics dashboard used to summarise crowd-sourced reports (Kossow & Dykes, 2018; Holeman et al., 2016). The platform gets its data through crowds. Crowds submit data via SMS, smartphone apps, email, Twitter or online (Holeman et al., 2016). Other technologies include online data mapping tools or dashboards and digital analytics technologies such as the DHIS 2.0 software that enables the processing of large amounts of data for easy visualisation (Holeman et al., 2016). In Uganda, the Ministry of Health uses DHIS 2.0 for data aggregation and presentation at the district level.

Digital Anti-Corruption for Mobilization

The highlighted technologies fight corruption in public sector institutions through increased transparency and accountability, provided citizens use them (Office of the President, 2008; Asiimwe, Wakabi & Grönlund, 2013). These technologies are heavily dependent on citizen participation (Gopakumar, 2001). Hence, another category of digital anti-corruption technology identified from

the literature is technologies for mobilisation. This category supports citizens' mobilisation to take up new technologies, changing their attitudes about corruption and generating political pressure for change. The use of blogging, SMS and social media in anti-corruption campaigns are typical examples. Other technologies used for mobilisation against corruption are videos and interactive websites, and citizen-government dialogue with SMS (Holeman et al., 2016). For example, in Tanzania, the Chanjo project used blogging, SMS and social media to mobilise citizens against corruption. The use of the Internet and social media enabled the project to reach 11,000 users in three months (Kossow et al., 2018; Holeman et al., 2016).

Digital Anti-Corruption for Automation

In this category, digital technologies are mainly used to automate discretionary activities with the potential for abuse among public officials (Kossow et al., 2018; Holeman et al., 2016). Automation helps eliminate the discretion of public officials, cuts out intermediaries, and reduces red tape and bureaucracy in the public sector. In turn, this reduces opportunities for corruption and favouritism by public officials (Gopakumar, 2001). Examples include the use of GPS and biometrics to detect staff absenteeism, disbursing salaries with mobile banking, checking for counterfeit medicines via SMS, and using algorithms to detect fraudulent data (Mutungi et al., 2019). For example, Kenyan Government introduced the use of digital cash registers to address the problem of staff stealing user fee revenue in government hospitals (Mutungi et al., 2019). Blockchain is being explored as a digital anti-corruption tool. The technology stores copies of data in different servers in a decentralised, peer-to-peer network in different locations around the world (Kossow et al., 2018). This design supports a verifiable record which cannot be changed without changing subsequent blocks, hence reducing chances for fraud to pass undetected (Kossow et al., 2018). However, developing countries like the three East African countries still have a long way to go in

implementing blockchain technology because of the lack of infrastructure (Kim and Kang, 2017).

These findings show that there are various digital anti-corruption tools in the public sector. However, existing attempts for classifying them do not fully address the different forms of corruption, activities and corruption procedures, public sector areas where corruption occurs, corruption enabling conditions, anti-corruption measures, conceptual aspects of corruption, underlying principles of anti-corruption and function of anti-corruption effort. Hence, the need to develop a more comprehensive digital anti-corruption typology that links digital anti-corruption tools to these corruption elements.

Identification and Definition of Digital Anti-Corruption Typology Elements

To identify the fundamental elements for producing a comprehensive classification of digital anti-corruption, existing corruption topologies were reviewed, covering both corruption and anti-corruption measures. Two frameworks stood out with common elements of corruption classifications, that is, the TASP framework and typology of anti-corruption policies. Consequently, elements from these two typologies were merged to generate a set of elements for informing a comprehensive typology of digital anti-corruption. The elements of the extended typology are forms of corruption, activities and corruption procedures, public sector areas where corruption occurs, corruption enabling conditions, anti-corruption measures, conceptual aspects of corruption, underlying principles of anti-corruption and the function of anti-corruption efforts.

Forms of Corruption

The first step towards developing a strong digital solution should involve the identification of the problem to be addressed. In this case, corruption is the targeted problem and therefore, its proper classification is very crucial. The analysis of the relevant literature revealed that corruption in the public sector could be classified as grand or petty, depending on the amount of money lost (Transparency International, 2015). Grand corruption is the abuse of high-level power that benefits the few at the expense of the many and causes serious and widespread harm to individuals and society (Transparency International, 2016). Petty corruption, on the other hand, is corruption in public administration at the political implementation end and involves the payment of comparatively small amounts of money to facilitate official transactions (Andvig, Fjeldstad & Søreide, 2000). Whether grand or petty, corruption can also be classified as political, administrative, or systemic (Rose-Ackerman & Palifka, 2016). Political corruption involves lawmakers (Andvig et al., 2000). Administrative corruption includes the use of bribery and favouritism to allow individual businesses to lower their taxes, escape regulations, or win low-level procurement contracts. Systemic corruption is where bribery is routine in dealings between the public and individuals. This type of corruption affects service delivery at all levels of society (Andvig et al., 2000).

Corruption has also been classified according to the perpetrators' behaviour. In this classification, corruption can entail nepotism, favouritism, bribery, extortion, intimidation, abuse of office, fraud, embezzlement, insider trading, conflict of interest, illegal contributions, or staff absenteeism (Suleiman & Othman, 2017). Nepotism implies the sharing of state resources, appointments and promotions with one's family members and relatives, not based on merits (Ijewereme, 2015). Related to nepotism is favouritism, preferential treatment by an entrusted office holder based on family or friendship relationship or ethnic, party, or religious affiliation (Andvig et al., 2000). Bribery is the act of offering and receiving extra-legal means to influence the performance of a constituted responsibility (Suleiman et al., 2017). Extortion involves coercive means to extract financial benefits while discharging one's official duty (Andvig et al., 2000). Abuse of power refers to a situation where

one's authority is unscrupulously applied to obtain preferential benefits (Agbiboa, 2015). Yet another form of corruption, among others, is the ghost worker, where the names of non-existing workers are added to the payroll to obtain undue salaries or subventions (Ijewereme, 2015). *Table 1* below illustrates the identified digital technologies which could be used to address the different forms of public sector corruption.

Table 1: Forms of corruption in the public sector

Category	Form	Digital measure
Grand	Bribery	Automation, Data aggregation and visualisation.
	Extortion	Service automation
	Embezzlement	Digital technologies for gathering information
	Fraud	Use of algorithms to detect fraud
	Political consideration	Digital technologies for mobilisation
	Kickbacks	Digital technologies for mobilisation
	Collusion	Use of algorithms to detect fraud
Petty	Theft, Extortion, Embezzlement, Intimidation	Digital technologies for gathering information.
	Fraud	Automation: use of algorithms to detect fraud
	Absenteeism	Automation: use of GPS and biometric systems
	Informal payments	Digital technologies for mobilisation
	Nepotism	Digital technologies for gathering information and service automation
	Favouritism	Service automation
	Insider trading	Use of algorithms to detect fraud
	Conflict of interest	Automation
Systemic	Can take on any form of corruption like Bribery, Extortion, Embezzlement	Digital anti-corruption for gathering data, data aggregation, data visualisation, mobilisation, and automation.

Analysis of the existing digital anti-corruption technologies shows a broad scope of technologies to prevent and or eliminate all types of public corruption identified in *Table 1* above. However, correct classification of the nature of corruption is fundamental to the design of digital technology towards the main features of the interested specific type of corruption. Correct classification ensures that the technology tool is well-fitting with the problem to collect data on the right phenomenon targeted by digital anti-corruption technology.

Activities and Procedures During Which Corruption Happens

The corruption types mentioned above can take place during different activities or procedures in the public sector (Villeneuve et al., 2017). It is crucial to understand the context where corruption takes place to design relevant contextual strategies as anti-corruption measures.

Villeneuve et al. (2017 identified the following main types of activities and procedures in the public sector where corruption takes place:

- Decision-making procedures: all those choices made for the correct functioning of a given organisation.

- Controlling and regulating activities for the general public: for example, the delivery of licenses and issuing of permits and documents.

- Delivering public utility or service: It refers to

the delivery of services to the general public such as electricity, water, and medical checks.

- Recruitment and promotion process in public service. Activities involved during recruitment and promotion of staff.

- Contract administration: activities aimed at issuing/renewing/terminating the contract of public administration personnel.

- Inspection: checking compliance with laws, regulations, policies, and procedures determined by public organisations among citizens and businesses.

- Stores Management refers to the proper recording, organisation, classification, and control of stocks within public administration. These stocks could be used for abusing power or paying bribes.

- Management of finances: this includes budget preparation and presentation, the public availability of information, open budget preparation, execution, and reporting, effective audit, and legislature oversight.

- Cash handling: management of cash collected within a public organisation.

- Government contract/public procurement: all activities and procedures related to procurement, from the invitation to tender to the selection of the project and award of contract.

The characteristics of corruption, its consequences, and its costs vary according to the type of activities and procedures when it happens (Villeneuve et al., 2017). Therefore, the different mechanisms and impacts of corruption also change based on the public sector where corruption takes place. *Table 2* below summarises these activities and procedures and the corresponding digital anti-corruption technologies.

Table 2: Digital anti-corruption by type of public sector activity or procedure

Activity/ procedure	Digital measure
Decision-making procedures	Automation- decision support systems, Accounting and auditing standards systems.
Controlling and regulating activities for the general public	Service automation
Delivering public utility or service	Accounting and auditing standards system.
Recruitment and promotion process in public service.	Automation- Recruitment and promotion system
Contract administration	Smart contracts can automate some accounting processes Digital technologies for gathering information and mobilisation promote participation of society in the prevention of corruption.
Inspection	Digital technologies for gathering information and mobilisation to promote participation of society in the prevention of corruption
Stores Management	Digitisation- e.g., using distributed ledger technology (DLT).
Management of finances	Digital technologies for gathering information and dissemination
Cash handling	Use of DLT for fraud minimisation, compliance, and efficiency through automation
Government contract/public procurement:	Automation of processes, e.g., e-procurement and smart contracts

Most of the identified digital anti-corruption technologies can prevent, detect, or eliminate corruption in controlling and regulating activities for the public, delivering public utility or service, recruitment and promotion process in public service and contract administration.

Decision-making procedures, store management, Inspection, Stores Management, and financial management have fewer digital anti-corruption technologies applicable to them from the literature. The proposed categorisation provides more elements to identify the type of problem digital anti-corruption should focus on.

The Public Sectors/Areas Where Corruption Occurs

Furthermore, corruption is categorised according to the public sector where it occurs since conditions, features, consequences, and impact of corruption across different sectors vary. For example, active bribery of a public official to obtain a construction permit has different mechanisms and consequences than illicit enrichment in disaster relief areas (Villeneuve et al., 2017). *Table 3* below shows digital technologies and different public sectors where they can be applied.

Table 3: Digital anti-corruption by type of public sector

Public sector where corruption may occur	Digital measure
1) Construction 2) Health 3) Tax Administration 4) Energy 5) Environment and water 6) Forestry 7) Customs and Immigration 8) Legal system 9) Disaster relief 10) Education	Digital anti-corruption for: • gathering data, • data aggregation, • data visualisation, mobilisation, and automation.

Much as it was crucial to identify the different categories of public sectors where corruption can occur, existing digital anti-corruption tools can be used across all the identified sectors.

Corruption-Enabling Conditions

Studies have established different situations, attitudes and processes that create an enabling environment or facilitate corruption in public service delivery (Mills, 2012). Corruption-enabling conditions include,

The poor institutional design of the political structure, legal structure, the rule of law, and culture amplifies the discretionary power of public officials which increases opportunities for corrupt behaviour (Rose-Ackerman et al., 2016). Organisational factors like a lack of moral criteria in promotions

and bad economic conditions create a fertile ground for corruption (Mele, 2019; Tanzi, 1998).

Low levels of development reduce education and literacy and limit the ability of citizens to serve as watchdogs over public officials' activities (Stapenhurst, Johnston & Pelizzo, 2006). Low public service wages (CIPE, 2011). Cultural environments that condone corruption. Some cultures defend and sometimes admire corrupt practices (Mele, 2019). Personal ethics and greed lead to an unfettered desire for money or power (Rose-Ackerman et al., 2016).

Information barriers and asymmetry between monopoly services and service recipients-citizens (Gopakumar, 2001). Lack of transparency and accountability also create opportunities for public officials to abuse their office for private gain (Rose-

Ackerman et al., 2016). Concerning these conditions that favour corruption, digital technologies can mainly be used to reduce too much discretion, monopoly power, lack of transparency, lack of accountability, limited citizens' voice, and enforcement. The rest of the enabling conditions, like low wages, personal greed, financial problems at home, social pressures, social norms, moral beliefs, attitudes, and personality, may not be reduced. Therefore, effective utilisation of the proposed typology also depends on other social, economic, political, infrastructural, and legal anti-corruption considerations.

Note that the main logic behind digital technologies used to reduce/eliminate corruption is to improve the supply and demand sides of information exchanges and limit the scope of public officials' discretion. However, this logic applies to limited forms of grand corruption where politicians may even legislate for corruption. Thus, while we recognise that technology usage to fight corruption is necessary, technology alone will never be sufficient to eliminate corruption. *Table 4* below summarises corruption-enabling conditions and digital technologies to limit them.

Table 4: Types of Digital Anti-Corruption Measures

Corruption-enabling conditions	Digital measure	Description
Lack of transparency and accountability	Transparency portals	Platforms that offer timely publication of key government documents online
Limited citizen voice	SMS	Citizen-government dialogue through SMS
Information barriers and information asymmetry	Crowdsourced reporting	Platforms that allow large numbers of citizens to report corruption or grievances
Discretionary power	Service automation	Automation replaces the discretionary decision
Monopoly power	Online services	Allowing citizens to serve themselves, reducing interaction with public officials
Information barriers and asymmetry	Social media and blogging	Mobilising the community to report incidents of corruption
	Open data portal	Providing free access to public data
	Internet services	Timely publication of information
Poor supervision of services	GPS and biometrics	Fighting public servant absenteeism
Lack of transparency and accountability	Automated audits of transactions	Removing intermediaries
Lack of transparency and accountability	Use of algorithms to detect fraud	Used to create an auditable log of transactions for easy detection of fraudulent activities

Anti-Corruption Measures

In the principal-agent lens, corruption is 'solvable' with policies that alter the degree to which principals can monitor and sanction their agents and the level of discretion given to agents and their incentive calculations (Marquette & Peiffer, 2015).

Consequently, anti-corruption measures should focus on reducing the discretion of civil servants, increasing monitoring mechanisms, promoting transparency in government, supporting anti-corruption civil society groups to serve as watchdogs, and strengthening sanctions on those who engage in corruption, to better align the

incentives of potential 'agents' with those of their respective 'principals (Marquette et al., 2015; Neupane, 2014). These measures can be direct measures that aim at specific manifestations of corruption and indirect measures that aim at removing or weakening conditions that favour corruption (Ebb, 2008).

The direct measures are aimed at fighting exact manifestations of corruption. This category includes financial audits to detect fraud, embezzlement, theft, or absenteeism; anti-corruption commissions to detect political corruption; or asset recovery for theft, embezzlement, or fraud (Marquette et al., 2015). Other measures are strengthening internal control systems, asset recovery, and monitoring and enforcement (Mills, 2012). *Table 5* summarises non-digital anti-corruption measures and corresponding digital technologies that may support them.

Table 5: Direct anti-corruption measures and corresponding forms of corruption

Anticorruption Measures	Forms of corruption	Digital measure
Anti-corruption commissions	Bribery Embezzlement Political corruption Collusion	All identified digital technologies
Prosecution of corrupt officials	Bribery Embezzlement Theft political	Digital anti-corruption for data collection and analysis
Code of Conduct for public officials	Bureaucratic corruption	Digital anti-corruption for mobilisation and sensitisation.
Assets Recovery	Theft Embezzlement Fraud Embezzlement	Digital anti-corruption for gathering data
Monitoring	Most forms of corruption	Digital anti-corruption for data aggregation and visualisation, gathering data, mobilisation, and automation.

Measures Addressing Corruption-Enabling Conditions

Indirect measures against corruption in public service delivery aim at weakening conditions that favour corruption (Office of the President, 2008). The indirect measures include monitoring of transactions to uncover opaque decision-making, civil service reform to address low public service wages, stringent code of conduct or addressing poor ethical issues, behaviour and transactional monitoring, staff rotation, breaking the culture of secrecy, cutting the red tape, and sensitisation of the public (Mills, 2012). *Table 6* summarises anti-corruption measures, conditions favouring corruption and the supporting digital technologies to address them.

Table 6: Indirect Anti-Corruption Measures

Anti-Corruption Measures	Conditions Favouring Corruption	Digital measure
Monitoring	Lack of transparency	Digital anti-corruption for data aggregation and visualisation, gathering data, mobilisation, and automation.
	Lack of accountability	
Introducing civil service reforms	Low public service wages	Automation
	Red tape	
Sensitisation of the public	Limited citizen voice	Digital technologies for mobilisation
	Cultural conditions	
	Information barriers and asymmetry	
Stringent code of conduct	Personal ethics	
Increasing access to information	Lack of transparency and accountability	Digital anti-corruption for data aggregation and visualisation
	Cultural conditions	
	Limited citizen voice	
	Information barriers and asymmetry	
Engaging service beneficiaries	Lack of transparency and accountability	Digital technology for both enhancing upward and upward transparency
	Cultural conditions	
	Limited citizen voice	
	Information barriers and asymmetry	
	Personal ethics	
	Limited citizen voice	
	Discretionary power	
	Monopoly power	

The Conceptual Aspects of the Anti-Corruption Measures

The conceptual aspect of anti-corruption measures concerns the underlying theoretical framework which informs anti-corruption initiatives. The framework outlines different corruption theories that explain corruption-enabling conditions and how anti-corruption mechanisms can address these conditions. The related theories are the principal-agent and collective action (Neupane, 2014; Osang, Abinwi & Tsuma, 2015).

Principal-Agent Theory

The principal-agent theory highlights the role of individuals' calculations about whether or not to engage in or oppose corruption; the influence of transparency, monitoring, and sanctions on those calculations; and the technical challenges of monitoring and sanctioning corrupt behaviour. This conceptualisation considers citizens as the principal and government officials, political leaders, and bureaucrats alike as agents acting on their behalf (Kossow, 2018; Neupane, 2014). The agents have political discretion and monopoly over the distribution of resources, hence a potential for corruption (Kossow, 2018; Neupane, 2014). Thus,

digital technology strategies to fight corruption should focus on decreasing the power discretion of individual government officials and on giving both their superiors and citizens the means to monitor their work (Kossow, 2018; Neupane, 2014).

Collective Action Theory

This theory highlights the relevance of individuals' decisions in group dynamics, including trust in others and the behaviour of others. When a group of individuals perceive corruption as normal and believe everyone else is involved, they may be less willing to abstain from it or take the first step in fighting it (Kossow, 2018). Strategies to fight this type of corruption aim to increase community engagement -public awareness raising and working with civil society to build trust in society through the potential benefits of mobile technologies (Kossow, 2018).

The Problem-Solving Perspective

The problem-solving perspective sees corruption as a way of dealing with deeply-rooted social, structural, economic, and political problems. Anti-corruption interventions need to understand the functions that corruption may serve and find alternative ways to solve problems that people face if anti-corruption work is to be successful (Marquette et al., 2015).

It is recognised that anti-corruption measures are influenced by the principal-agent problem (Marquette et al., 2015). According to the principal-agent paradigm, the contemporary anti-corruption framework mainly concerns policies and measures aimed at reducing the opportunities and incentives for corruption. Most of the identified anti-corruption measures are related to the principal-agent paradigm summarised in *Table 7* (Villeneuve et al., 2020).

Table 7: Conceptual aspects

Conceptual aspect	Digital technology
Principal-Agent Theory	Digital anti-corruption for automation and data aggregation and visualisation
Collective action theory	Digital anti-corruption for automation and data aggregation and visualisation
The problem-solving perspective	Digital Anti-Corruption for Mobilization

Main Anti-Corruption Principles

The principles of anti-corruption are transparency, accountability, and integrity (UNDP, 2015). Transparency is the availability of information to the public and the government workforce (UNDP, 2015). Accountability, on the other hand, refers to the rights of citizens to request a response to

questions about government decision-making and the obligation of the government to respond (UNDP, 2015). These principles are the fundamental building blocks of integrity that inform anti-corruption measures (Villeneuve et al., 2020). *Table 8* below shows how digital anti-corruption is according to the underlying principles of corruption.

Table 8: anti-corruption principles

Anti-corruption principle	Digital anti-corruption
Transparency	Digital anti-corruption for data aggregation and visualisation, gathering data and automation.
Accountability	Digital anti-corruption for data aggregation and visualisation, gathering data, mobilisation and automation.
Integrity	Digital anti-corruption for reporting by public officials of acts of corruption

All the identified digital anti-corruption technologies in the public sector are at least based on transparency, accountability, or integrity principles.

According to Villeneuve et al. (2020), identifying the function of the anti-corruption measure; helps to apply the correct type of technology. There are four main functions of the anti-corruption measures; prevention by increasing the transparency of public operations through the adoption of measures to facilitate access to information; prevention by changing the logic of action which leads the public to bribery and detecting potential cases of corruption and setting up State mechanisms to investigate and sanction the breaching of the law".

Most of the identified digital anti-corruption measures are for either corruption detection and reporting or prevention of corrupt behaviours. *Table 9* below summarises the digital anti-corruption by the function of anti-corruption measures.

Table 9: Digital anti-corruption by the function of anti-corruption measure

Function of anti-corruption measure	Digital anti-corruption
Prevention	Digital anti-corruption for data aggregation, visualisation, mobilisation
Detection	Digital anti-corruption for gathering information
Elimination	Automation

DISCUSSION

The main research question of this study was "what is the typology for digital anti-corruption that can improve the anti-corruption performance in the public sector?"

The study used scoping review methods by Arksey and Malley (2005) to answer the research question. Through the review, mobile technologies used against corruption in the public sector were established and classified. The categories were: digital anti-corruption technologies for gathering information, data aggregation and visualisation, mobilising the public to demand accountability and automation and auditing to address fraud (Holeman et al., 2016). The categories show how digital technologies fight corruption in the public sector. Based on their functionalities, the technologies are classified into a typology (Adam & Fazekas, 2018). The typology highlights that digital technology can assist in corrupt practices, for example, theft, falsification, and destruction of digital records. On the hand, digital technology aids the fight against corruption, for example, mobile channels to report corruption incidents, automated audits of the transaction to uncover fraudulent payments, or service automation to replace discretionary decision-making by public officials with rule-based automated decision-making. The typology is in agreement with the principal-agent theory that

strategies to fight corruption should focus on decreasing the power discretion of individual government officials (Kossow, 2018; Neupane, 2014) and the collective action theory that strategies to fight corruption should aim at increasing community engagement (Kossow, 2018).

This typology supports decisions on what digital measures to apply to fight against corruption or address specific corruption-enabling conditions. The typology has implications for e-government implementation, in particular for the research area of digital anti-corruption. First, it is noted that many digital tools have not been performing well in practice due to their non-alignment with the nature of corruption, public sector areas and activities where corruption occurs, corruption enabling conditions, anti-corruption measures, conceptual aspects of corruption, the function of anti-corruption effort, and underlying principles of anti-corruption. Governments can overcome this challenge and improve their anti-corruption performance by acquiring digital anti-corruption tools for monitoring the delivery of public services or tailored tools to address the specific category of corruption. Second, some digital anti-corruption tools like crowdsourcing or whistleblowing platforms constitute a risk to users if not protected. Thus, relevant authorities must introduce security mechanisms and laws to protect the users of such platforms. Thirdly, several digital anti-corruption tools have not realised their potential due to limited usage. One of the usage barriers is the capacity gap, so relevant authorities should endeavour to train potential users while protecting their identity. Lastly, some digital anti-corruption tools have had limited impact because of their availability. Therefore, relevant authorities should sensitise members of the public about the availability and security of such tools.

CONCLUSIONS

The study examined the digital technology tools to support direct and indirect anti-corruption measures against public sector corruption. After reviewing literature using scoping review methods, many of these digital anti-corruption tools have not been performing well in practice due to their non-alignment with the nature of corruption, public sector areas and activities where corruption occurs, corruption enabling conditions, anti-corruption measures, conceptual aspects of corruption, the function of anti-corruption effort, and underlying principles of anti-corruption.

This paper contributes to addressing this gap by offering a typology of digital anti-corruption in the public sector that guides measures to fight against specific categorisations of corruption. The typology guides deploying digital anti-corruption tools or combinations to match specific corruption threats and conditions that enable and trigger such threats in different public sector areas.

Although four categories of digital anti-corruption are identified as the tools used against corruption in the public sector, this study used only a literature review. It is possible that there could be other forms of undocumented corruption or conditions that are not met by these measures. Therefore, future researchers should consider extending this typology using alternative research methods and use it to check whether there are forms of corruption or conditions that are not met with the identified measures.

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