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Digital solutions as an effective approach to combat corruption in public procurement

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Abstract. This study examined the issue of corruption in Ukraine within a socio-political context, highlighting that despite the implementation of digital tools like Prozorro and Dozorro, the country continued to face reputational challenges due to persistent corrupt activities. The aim was to explore how digital solutions can serve as an effective tool to combat corruption in public procurement processes and their potential to enhance transparency, accountability, and efficiency. The study employed a mixed-methods approach, integrating qualitative and quantitative techniques to explore the use of digital tools in combating corruption in Ukraine. Data from Prozorro and Dozorro systems from 2020 to 2024 were analysed, along with reports from NABU (National Anti-Corruption Bureau of Ukraine) and SAPO (Specialised Anti-Corruption Prosecutor's Office), and high-profile journalistic investigations like the Panama Papers and Pandora Papers. Despite advanced digital initiatives, Ukraine continued to face reputational challenges due to ongoing corruption reports. The study found that digital tools, such as blockchain and AI, have potential to enhance transparency and efficiency in public procurement. Challenges during wartime were also highlighted, showing the complexity of combating corruption under such conditions. The research emphasised the importance of international collaboration and public involvement in overseeing government activities. It concluded that a comprehensive strategy combining legal reforms, digital technologies, public oversight, and international cooperation is essential to reduce corruption and foster trust in public institutions. The practical value of this research lies in the development of a multi-faceted anti-corruption approach that integrates these key elements to build a culture of integrity and trust within public institutions

Keywords: digital tools; transparency; public procurement system; Prozorro; methods of combating corruption; blockchain, anti-corruption policy

Introduction

Corruption in the field of public procurement is one of the key threats to sustainable development, effective public governance, and ensuring socio-economic progress in Ukraine. Of particular concern is corruption in public procurement, which undermines trust in state institutions, reduces the efficiency of budget spending, and deprives citizens of equal access to public resources. In the modern context of globalisation and digitalisation, corrupt schemes are becoming increasingly complex, and combating them requires innovative and technological solutions. Digital technologies play a crucial role in enhancing transparency, accountability, and integrity in public administration. They

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can significantly reduce corruption risks by automating procurement processes, eliminating human intervention, and enabling more effective oversight. The study of digital tools to counteract corruption in public procurement is vital for Ukraine, considering current challenges related to the war, the need for international support, and commitments undertaken on the path to European integration. The digitalisation of this sector will not only help to reduce abuses but also improve the efficiency of public resource utilisation, which is critically important in the context of the country's post-war recovery.

For this research, it was valuable to rely on the approach of interpreting corruption and identifying the factors that contribute to this phenomenon, using the example of Estonia, which claims to be approaching zero corruption for sustainable development. N. Khoma & I. Vdovichin (2024) identified two types of corruption factors: the first group that contributes to Estonia's anti-corruption progress and the second that impedes Estonia's progress on the path to eliminating corruption. The study showed that the introduction of digital technologies, such as e-government systems, effectively reduces corrupt practices. The shift to e-government has greatly contributed to reducing corruption in Estonia.

Given that Ukraine is currently in a state of war, it was deemed necessary to investigate the main challenges arising during the development and implementation of methods to combat corruption in such conditions. The article by K. Nesterenco & O. Bulgakova (2023) explored issues such as resource scarcity, the impact of globalisation on corruption, and the adaptation of anti-corruption policies during wartime. It has been demonstrated that, alongside countering military aggression, combating corruption must become an equally significant priority for all government bodies today. Specifically, article by A. Mazaraki *et al.* (2023) analysed how corruption affects economic security and growth amidst Ukraine's deteriorating economic conditions. The author concludes that systematic measures to prevent and combat economic corruption are essential, and achieving economic security should be a key component of the national anti-corruption policy.

A team of Ukrainian scientists analysed best practices and focused on the fight against corruption in contemporary public administration. V. Nonik *et al.* (2024) studied the factors influencing the effectiveness of anti-corruption measures in the context of rapid technological development were relied upon. The article examines the fight against corruption in contemporary public administration, focusing on the factors that affect the effectiveness of anti-corruption measures in the context of globalisation and technological development, and emphasises the importance of studying and applying best practices from other countries. The conclusion highlights the necessity of developing transparent institutions, enhancing civic awareness, and fostering international cooperation to create an effective anti-corruption system, especially during times of war.

S.M. Chege & D. Wang (2020) analysed the literature on the impact of information technology innovations on the fight against corruption in small and medium-sized enterprises in developing countries. Corruption, as a negative phenomenon, inhibit business development, hindering entrepreneurial and innovative efforts. They identified encouraging employees to report corruption in their workplaces as one of the methods of fighting corruption. Many employees were reluctant to report corruption due to inadequate whistle-blower protection policies. Additionally, while information technology had the potential to help identify whistle-blowers, its use remained limited due to fear and uncertainty. The effectiveness of anti-corruption strategies depended on their alignment with the local cultural, ecological, and technical context. To address this issue, the government needed to raise public awareness of whistle-blower protection and create an interagency framework to improve digital reporting channels in both the public and private sectors

Significant contributions to the typology of digital tools for preventing and fighting corruption were made by foreign researchers such as M. Fredrick *et al.* (2019). The typology emphasised that digital technology could both facilitate corruption, such as through the theft of digital personal records, and support anti-corruption efforts, such as by providing mobile channels for reporting corruption, conducting automated audits of transaction records to detect fraudulent payments, or automating services to replace discretionary decisions by public officials with rule-based automated processes.

The literature review revealed that while significant progress had been made in Ukraine's anti-corruption efforts, particularly through the implementation of digital tools like Prozorro and Dozorro, challenges persisted due to ongoing corrupt activities. In light of these challenges, digitising anti-corruption mechanisms became increasingly relevant for enhancing process efficiency and transparency. However, despite the potential of these initiatives, most scientific publications focused on isolated cases of anti-corruption digitisation at the state level. There remains a notable gap in research providing a comprehensive analysis of how digital tools can combat corruption on a global scale. Additionally, there is a lack of understanding on how to adapt anti-corruption policies during wartime, the role of public involvement, and the integration of international best practices. Therefore, this study aimed to evaluate the effectiveness of digital tools in combating corruption in Ukraine, especially in the context of the ongoing war and rapid technological advancements.

Materials and Methods

This article explores the used of digital tools in combating corruption in Ukraine, employing a mixed-methods approach that integrates both qualitative and quantitative techniques. The research utilised data from two primary digital platforms: the Prozorro public procurement system (Official website of the Prozorro, n.d.) and the Dozorro

public oversight monitoring portal (Official website of the Dozorro, n.d.). Data from these platforms was analysed to assess the effectiveness of digital tools in combating corruption in public procurement. The analysis covered the period from 2020 to 2024. The data was visualised in graphs to illustrate the changes in procurement spending, particularly highlighting the impact of the full-scale invasion starting in February 2022. Reports from NABU and SAPO (Official website of the National Anti-Corruption Bureau of Ukraine, n.d.) were analysed to understand the nature and outcomes of recent investigations related to procurement fraud.

The article also incorporated data from journalistic investigations such as the Pandora and Panama Papers (Offshore leaks database, n.d.), which exposed offshore dealings of prominent Ukrainian officials. These reports were used to contextualise the global reach of corruption and its implications for public procurement in Ukraine. The NABU's annual anti-corruption reports (Official website of the National Anti-Corruption Bureau of Ukraine, 2023) provided an analysis of current anti-corruption efforts and challenges in combating procurement fraud.

International transparency surveys, such as Transparency International's Corruption Perceptions Index (Official website of the Transparency International, 2023), and data of local polls conducted by Ukrainian civil society organisations and NGOs commissioned by USAID (The state of corruption in Ukraine…, 2023), were reviewed to assess public confidence in anti-corruption efforts. These surveys helped in understanding the public perception of procurement transparency and the effectiveness of anti-corruption measures.

The potential of artificial intelligence (AI) and big data in detecting and preventing corruption in procurement were explored through methods such as machine learning, pattern recognition, and anomaly detection. The research also considered the implementation of blockchain technologies to ensure data immutability and security in public procurement.

Diverse methods were employed to define strategies for combating corruption in Ukraine's public procurement processes. These methods included content analysis of theoretical scientific articles, legal analysis of the Law of Ukraine No. 922-VIII "On Public Procurement" (2015), and a review of reports from Transparency International (Transparency International, 2024). The combination of legal reforms, digital technologies, public oversight, and international cooperation was examined using qualitative and quantitative analysis to understand their collective impact on reducing corruption and fostering a culture of integrity and trust within public institutions.

Results and Discussion

Although Ukraine implemented digital models for combating corruption, such as the Prozorro public procurement system and the Dozorro public oversight monitoring portal, it continued to suffer reputational damage due to frequent reports of corrupt actions by politicians and business representatives in the international media. Anti-corruption initiatives typically encounter two major challenges: a lack of sufficient financial and human resources, and the absence of a credible support base. The effective anti-corruption organisations are those that successfully address at least one of these challenges. Additionally, political will among local authorities is found to be a crucial factor in the success of anti-corruption efforts (Bader *et al.*, 2019).

Addressing corruption requires a multifaceted approach that extends beyond digital tools. Ukraine has implemented several methods to combat corruption in public procurement, combining reforms, investigations, and advanced digital tools (Table 1).

Table 1. *Methods to combat corruption in public procurement*

Main approaches	Details of implementation
Reforms in Public Procurement	▪ **Prozorro System**: One of the most prominent reforms, Prozorro, is a digital platform designed to ensure transparency in public procurement. Launched in 2016, it mandates that all public tenders be conducted online, allowing anyone to monitor the procurement process from start to finish. This reduces the risk of hidden agreements and increases accountability. ▪ **Dozorro Monitoring Portal**: Complementing Prozorro, Dozorro enables civil society and the public to monitor procurement processes, report violations, and provide feedback on tenders. This enhances oversight and public engagement in preventing corruption.
Investigations by Anti-Corruption Bodies	▪ **National Anti-Corruption Bureau of Ukraine** (NABU) is responsible for investigating into the misuse of public funds, high-level corruption, including fraud in public procurement. Recent cases included targeting senior officials involved in corrupt procurement schemes, such as the "Rotterdam+" case, which involved inflated electricity tariffs, and the "Ukrzaliznytsia" case, which focused on corruption in the state railway company. Specialised Anti-Corruption Prosecutor's Office (SAPO) works alongside NABU to prosecute cases of corruption, playing a critical role in holding offenders accountable through legal action. ▪ **The National Agency on Corruption Prevention** was established as a result of anti-corruption reforms and serves as the central executive body in Ukraine with a special status. It is responsible for ensuring the formation and implementation of state anti-corruption policy. This government agency is tasked with performing preventive functions, including the verification of the lifestyle and declarations of public officials. Additionally, it holds the authority to disclose any information regarding instances of abuse of office or corruption by public officials (Skyba, 2023).
High-Profile News and Reports	▪ Pandora and Panama Papers: Journalistic investigations have exposed the offshore dealings of prominent Ukrainian officials, highlighting corruption's global reach. These revelations have fuelled domestic efforts to clamp down on financial fraud linked to public procurement (Offshore leaks database, n.d.). ▪ Annual Anti-Corruption Reports: NABU and other bodies release reports on corruption cases, public procurement fraud, and ongoing investigations, offering transparency on efforts to combat the issue.

Table 1. *Continued*

Main approaches	Details of implementation
Surveys and Public Perception	▪ **International Transparency Surveys**: Ukraine's efforts are measured in global surveys such as Transparency International's Corruption Perceptions Index, which highlights public trust in anti-corruption efforts. These surveys often show that despite reforms, public scepticism remains due to persistent cases of high-level corruption. ▪ **Local Polls and Reports:** Ukrainian civil society organisations and NGOs regularly conduct surveys on public procurement transparency. Reports from organisations like the Anti-Corruption Action Centre (Official website of the Anti-Corruption Action Centre. n.d.) track progress and highlight ongoing issues in implementation and enforcement of anti-corruption measures.

Source: *compiled by authors*

These efforts reflect a multi-faceted approach, blending legal reforms, technology, and public oversight to reduce corruption in Ukraine's public procurement processes (Fig. 1). The multifaceted approach to combating corruption in Ukraine involved legal reforms, including the Law of Ukraine "On Public Procurement" and the WTO Agreement on Government Procurement. Digital technologies and tools, such as the Prozorro system and the Dozorro monitoring portal, were implemented to enhance transparency and accountability. Public supervision and control were strengthened through high-profile news and reports, public perception surveys, and investigations conducted by anti-corruption bodies.

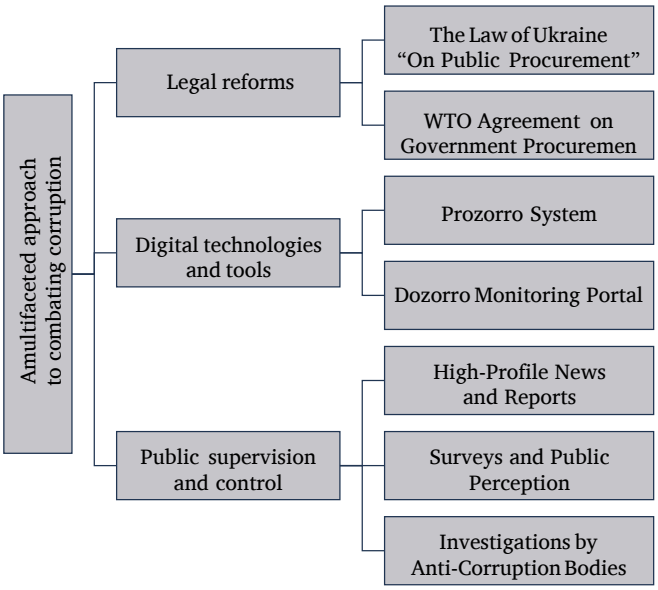

Figure 1. *A multifaceted approach to combating corruption*

Source: *compiled by authors*

In conclusion, the multifaceted approach to combating corruption in Ukraine effectively integrates legal reforms, digital technologies, and public oversight. By implementing the Law of Ukraine "On Public Procurement" and adhering to international standards like the WTO Agreement on Government Procurement, the legal framework has been strengthened to facilitate transparency and accountability. The use of innovative tools such as the Prozorro System and the Dozorro Monitoring Portal has revolutionised procurement processes, ensuring that all activities are conducted openly and monitored by the public.

Furthermore, the role of media reporting, public perception surveys, and investigations by anti-corruption bodies highlights the importance of civil engagement and vigilance in tackling corruption. Together, these elements create a robust and comprehensive strategy that not only addresses existing corruption but also fosters a culture of integrity and trust within public institutions.

The report on the state of corruption in Ukraine in 2023, conducted by the Kyiv International Institute of Sociology (KIIS) as part of the "Join!" Civic Engagement Promotion Program and the USAID Project "Support to Anti-Corruption Champion Institutions in Ukraine" (SACCI) (The state of corruption in Ukraine…, 2023), reveals several key findings regarding public perception, experience, and attitudes towards corruption. The survey covered three representative samples: general population, internally displaced persons (IDPs), and externally displaced persons (EDPs), to understand the different realities caused by the war.

1. Public perception of corruption. Corruption is considered the most serious problem for Ukraine after the full-scale war, according to 89% of citizens. Political corruption is identified as the most critical type, with 81% of respondents highlighting it. 94% of respondents still believe that corruption is widespread across Ukraine. The percentage of those who are convinced that the level of corruption

has increased since the start of the full-scale war exceeds the percentage of those who believe it has decreased.

2. Experience with corruption. The percentage of respondents who encountered corruption in the past year varies, with 14% of the general population and IDPs, and 18% of EDPs reporting such experiences. However, a significant portion of respondents, especially EDPs, were reluctant to provide specific answers about their encounters with corruption.

3. Public trust and reporting. According to a poll by the Razumkov Center (2024), nearly 60% of Ukrainians do not trust the National Anti-Corruption Bureau (NABU) and the Specialised Anti-Corruption Prosecutor's Office (SAPO). This level of distrust has increased since the previous survey, which is attributed to the lack of verdicts in high-profile cases. The survey, conducted by the Razumkov Center in September 2024, highlights the very low public trust in these anti-corruption bodies. Only 3.8% of respondents fully trust the NABU and the SAPO. Notably, distrust in these agencies has risen compared to the previous survey conducted (National Democratic Institute, 2024). At that time, just over 30% of respondents trusted the NABU, and 20% trusted the SAPO.

4. Awareness and effectiveness of anti-corruption efforts. Awareness of anti-corruption measures and campaigns has decreased compared to 2018, but the perception of their effectiveness has improved. Nearly 80% of citizens are willing to participate in protests and public actions, although most prefer passive forms of engagement, such as reporting corruption through media and social networks (31%) and signing electronic petitions (27%).

5. Optimism and engagement. Internally displaced persons show the highest optimism regarding the level of corruption and anti-corruption efforts, while externally displaced persons are more sceptical. The general population and IDPs are more likely to believe that citizens should take responsibility for combating corruption, with an increase from 9% in 2021 to 13% in 2023.

Despite the low levels of trust, according to D.A. Bilenets *et al.* (2024), an analysis of legal norms and institutional frameworks indicated that Ukraine's anti-corruption measures aimed to ensure maximum transparency and accountability in government activities. Key institutions like the National Agency on Corruption Prevention (NACP), the National Anti-Corruption Bureau of Ukraine (NABU), and the Specialised Anti-Corruption Prosecutor's Office (SAPO) played crucial roles in monitoring compliance with anti-corruption legislation and investigating significant corruption cases. Therefore, there should be improvements to increase public trust in these institutions.

The war has intensified the complexity of corruption issues, and there is a need for continued efforts to enhance transparency, accountability, and public involvement in anti-corruption initiatives. Surveys play a vital role as an instrument for combating corruption by providing valuable insights into public perception, experience, and attitudes towards corruption. They help identify areas where anti-corruption efforts are most needed and gauge the effectiveness of existing measures. By highlighting the public's concerns and willingness to engage in anti-corruption activities, surveys can guide policymakers in designing more targeted and effective strategies. Additionally, surveys help build transparency and accountability by making the voices of citizens heard in the fight against corruption.

Intolerance towards corruption within Ukrainian society and the recognition of the importance of combating it, as highlighted in the analysis above, are crucial. However, to assess the extent to which the authorities' actions align with citizens' expectations regarding the handling of corruption cases, statistics on criminal proceedings in corruption cases were analysed.

Criminal proceedings in public procurement play a crucial role in maintaining the integrity, transparency, and accountability of governmental and public sector transactions. Given the substantial funds involved, public procurement is often susceptible to corruption, fraud, bid-rigging, and other illegal activities that can erode public trust and misappropriate resources intended for public services. The initiation of criminal proceedings acts as a powerful deterrent, holding individuals and organisations accountable for any violations and ensuring that procurement processes are fair and lawful. The state of criminal proceedings in the field of public procurement in Ukraine from 2020 to 2024 was considered (Fig. 2.).

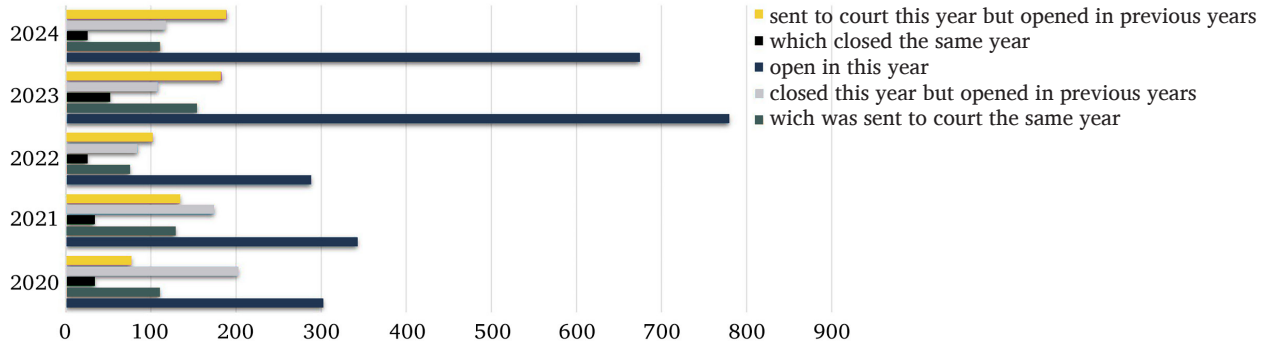

Figure 2. *Criminal proceedings in public procurement in Ukraine*
Notes: *data for the year 2024, covering only January to June*
Source: *compiled by authors using data of Y. Pylypenko (2024a)*

From 2020 to 2022, there was a relatively stable level of open procurement cases, with a gradual decrease in the number of cases closed and sent to court. In 2023, the number of open cases sharply increased to 779, almost doubling the figures of previous years, while the number of cases sent to court also significantly rose. The significant rise in open procurement cases in Ukraine in 2023 could be linked to enforcement of anti-corruption measures, resulting in a higher number of reported irregularities and ensuing investigations. Additionally, the large share of closed cases originating from previous years highlights the extended duration of the review process, indicating systemic delays or complexities in resolving procurement cases. This prolonged review timeline may point to challenges in resource allocation, procedural bottlenecks, or the complexity of the cases themselves, which together impact the efficiency of case closure and legal processing in the procurement system.

To address challenges and enhance the efficiency of anti-corruption efforts, Ukraine has effectively employed AI technologies in public procurement. The Prozorro public procurement system uses AI to analyse data and identify suspicious patterns, such as unusually high bid prices or frequent contract amendments, improving the detection of corrupt practices (Transparency International, 2018). Prozorro has integrated blockchain technology to enhance transparency and security in procurement transactions, with AI algorithms ensuring all steps are recorded immutably (Charting a course for change…, 2024). These AI technologies have significantly enhanced transparency, accountability, and integrity in Ukraine's public procurement processes, reducing opportunities for corruption and fostering trust in public institutions.

Digital tools play a crucial role in combating corruption in public procurement by making processes more transparent, efficient, and less susceptible to manipulation. One of the most well-known examples is the Prozorro public procurement system, which has been implemented in Ukraine and gained international recognition. Through its operations, transparent access to tenders is ensured, reducing the risks of hidden agreements between buyers and suppliers. Prozorro allows every citizen to observe all stages of procurement – from the tender's announcement to the contract's signing.

The success of Prozorro can be quantified through various metrics. According to experts, the effectiveness of Prozorro is measured by relative indicators such as the level of competition and relative savings. In 2021 and 2022, these savings amounted to nearly 6%. This indicates that suppliers, after conducting tenders, typically received prices that were 6% lower than the expected cost (Rysin & Sukh, 2024). Prozorro's effectiveness is further demonstrated by its ability to increase transparency, reduce corruption, and foster a more competitive procurement environment, making it a model for other countries to follow.

Another important component is the Dozorro monitoring portal, which ensures public oversight of procurement processes. This tool allows users to track potential violations, provide feedback, and notify relevant authorities about suspicious activities. Combining government initiatives with public scrutiny significantly increases the level of responsibility and accountability of participants in the process.

As an example, the Dozorro team has been monitoring advertising service (Pylypenko, 2024b). They analysed procurements under the specific classification code 79340000-9 – Advertising and Marketing Services, and relevant keywords. As demonstrated in Figure 3, during the first year of the full-scale invasion (February 24, 2022 – February 24, 2023), advertising contracts amounted to 262 million UAH. At the same time, purely in the calendar year 2022, spending on advertising through Prozorro was almost half of that in the pre-war year 2021 – 225 million UAH compared to 441 million UAH. However, in 2023 and 2024, this amount increased. In just under 7 months of 2024, contracts worth 362 million UAH have already been signed. Almost 72% of the total amount is accounted for by two regions: Kyiv (178 million UAH) and Dnipropetrovsk (86 million UAH).

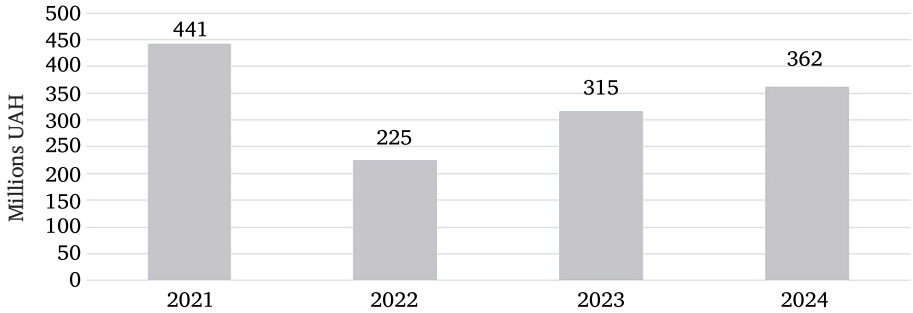

Figure 3. *Advertising expenses in Prozorro over the past four years*
Notes: *data for the year 2024, covering only January to July*
Source: *compiled by authors using data of Y. Pylypenko (2024b)*

Using the interactive portal, it was evident where hundreds of millions of state funds had been allocated to local government advertising, allowing for an analysis of potential corruption risks. The risk analysis of these cases suggested that spending on advertising during the war might not have been the best idea due to the significant

allocation of state funds towards non-essential services at a time when resources were critically needed for defence and humanitarian efforts. The analysis of advertising and marketing services procurements revealed that, despite the ongoing conflict, substantial amounts were spent on advertising, with contracts amounting to 262 million UAH in the first year of the full-scale invasion and increasing to 362 million UAH in just under seven months of 2024.

While it was not suggested that all budget spending on advertising should cease, the allocation of substantial funds to advertising during wartime raised concerns about the prioritisation of state resources and the potential for corruption, particularly in regions like Kyiv and Dnipropetrovsk, which accounted for almost 72% of the total spending. Redirecting funds from advertising to more critical areas could have enhanced resource allocation efficiency and supported essential services, thereby addressing immediate wartime needs and reducing corruption risks.

In addition, the publication of open data on procurement and other government operations fosters a competitive environment and reduces the risk of collusion among participants. Open access to information enables the public, journalists, and non-governmental organisations to monitor violations and influence their correction. In case when open data on procurement is actively published, companies bidding on government contracts have access to detailed information on pricing, selection criteria, and contract terms. This transparency makes it harder for groups to engage in bid-rigging or collusion, as competitors can more easily identify unusual patterns or red flags in the procurement process.

Additionally, in cases where procurement data is made publicly accessible, journalists and civil society organisations can play a "watchdog role" by investigating and reporting on irregularities. For instance, if an NGO detects that a contract was awarded to a company with ties to officials without proper competitive bidding, they can bring attention to the issue, prompting corrective action by oversight bodies. This public oversight not only pressures governments to adhere to fair procurement practices but also empowers citizens to demand accountability in government spending.

The analysis of reports from the National Anti-Corruption Bureau of Ukraine (NABU) and the Specialised Anti-Corruption Prosecutor's Office (SAP), combined with findings from the Pandora and Panama Papers (Offshore leaks database, n.d.), indicates that corruption schemes in Ukraine's public procurement sector are complex and multi-layered. These schemes involve collusion between officials and businessmen, the use of offshore companies to conceal illicit gains, and the abuse of official powers.

The Pandora and Panama Papers investigations have unveiled the offshore dealings of prominent global figures, including the King of Jordan, the presidents of Ukraine, Kenya, and Ecuador, the prime minister of the Czech Republic, and former British Prime Minister T. Blair. These documents also reveal the financial activities of more than 130 billionaires from various nations, including Russia, the United States, and Turkey. Notably, the investigations highlight the role of Baker McKenzie, the largest law firm in the U.S., in shaping the modern offshore system and profiting from work done for individuals linked to fraud and corruption.

The investigations demonstrate the effectiveness of uncovering corruption by highlighting how influential entities like Baker McKenzie have shaped financial laws to benefit their clients, including Ukrainian oligarch I. Kolomoisky, who is accused of laundering $5.5 billion through a network of shell companies. This underscores the importance of rigorous investigations in exposing and addressing complex corruption schemes (Offshore havens and hidden…, 2021). As a result, these investigations were helping to bring prominent oligarchs, such as I. Kolomoisky, to justice, demonstrating the critical role of comprehensive probes in holding powerful individuals accountable for their corrupt activities. This emphasised the necessity of maintaining transparency to ensure accountability.

Furthermore, the success of anti-corruption strategies depends on their alignment with local environmental, cultural, and technical contexts. The government should enhance public awareness of whistle-blower protections and create a multiagency framework for digital whistleblowing channels. Policymakers must bridge the gap between anti-corruption law enforcement and practical implementation (Chege & Wang, 2020). A. Mungiu-Pippidi (2015) emphasised the role of governance and institutions in controlling corruption, advocating for the construction of transparent and accountable institutions. A. Mungiu-Pippidi posited that digital tools can bolster anti-corruption efforts but must be integrated into a broader strategy that includes legal and institutional reforms.

Civil society organisations in Ukraine play a crucial role in combating corruption and ensuring transparency in government management processes. The forms of public oversight and their use of digital tools to influence the public procurement system were analysed in Table 2.

Table 2. *Role of civil society organisations in influencing public procurement in Ukraine*

Organisation name	Influence tools	Focus of action (expected outcomes)
Transparency International Ukraine	Analytical reports, research, advocacy	Increasing transparency and accountability in public procurement, reducing corruption levels
Anti-Corruption Action Centre (AntAC)	Investigations, legal support, public campaigns	Bringing corrupt officials to justice, strengthening the legal framework
Nashi Groshi	Journalistic investigations, publications	Exposing corruption schemes in public procurement, informing the public
StateWatch	Monitoring, analytics, public reports	Increasing transparency of public finances, preventing corruption risks

Table 2. *Continued*

Organisation name	Influence tools	Focus of action (expected outcomes)
Public Control (DOZORRO)	Online monitoring platform, violation reports	Enhancing public oversight of public procurement, reducing corruption risks
Anti-Corruption Headquarters	Analytics, advocacy, public campaigns	Increasing transparency and accountability, preventing corruption schemes in public procurement

Source*: compiled by the authors*

The analysis above highlights how various civil society organisations in Ukraine are utilising a range of influence tools to impact the public procurement system. Through analytical reports, investigations, public campaigns, and monitoring platforms, these organisations aim to increase transparency, accountability, and public oversight. Their efforts collectively contribute to reducing corruption, exposing fraudulent activities, and strengthening the legal framework governing public procurement. By leveraging these diverse strategies, these organisations play a crucial role in fostering a culture of integrity and trust within Ukraine's public procurement processes. One significant challenge to enhancing government transparency is establishing a regulatory or legal framework that governs its processes and enables the measurement of transparency or corruption levels across various departments. Consequently, tools and metrics are vital for monitoring the anticipated changes. Implementing a model directly within the organisation is essential for achieving fundamental transparency in E-government (Hochstetter *et al.*, 2023).

Ensuring access to digital tools for a wide range of civil activists, journalists, and non-governmental organisations is also crucial. This will promote establishing a robust public monitoring network capable of swiftly responding to violations detected in public procurement systems. Creating accessible and user-friendly platforms for citizen interaction with government systems will enhance public engagement in oversight processes.

The continued development of digital tools in public procurement has significant potential to enhance anti-corruption measures. A key direction is the improvement of automated systems that not only detect violations but can also predict risks and prevent corruption schemes at early stages. For example, predictive algorithms based on analysing previous tenders can help identify signs of collusion between participants or buyers. These algorithms allow for the detection of behavioural patterns typically associated with corrupt actions, such as repeated wins by the same participant or inefficient use of public funds.

The beta version of the Dozorro system, presented by Transparency International Ukraine, uses artificial intelligence to identify tenders with a high risk of corruption. Unlike the State Audit Service's 35 fixed risk indicators, Dozorro's AI is flexible and adjusts automatically to new "trickery algorithms" used by corrupt officials. During beta testing, the AI algorithm demonstrated significant accuracy, identifying 26% more unfounded winner selections, 37% more groundless disqualifications, and 298% more cases of participant collusion, particularly in the most expensive tenders (Transparency International, 2018).

The continued development of digital tools in public procurement, such as the flexible and adaptive Dozorro AI system, has shown significant potential in enhancing anti-corruption measures by accurately identifying high-risk tenders and detecting corrupt practices, as evidenced by its beta testing results.

Moreover, an important aspect is the development of international cooperation in the digitalisation of anti-corruption measures. The globalisation of corrupt practices, such as using offshore accounts or shell companies to conceal ownership, requires synchronised actions at the international level. Open registries of beneficial owners, shared databases, and the integration of national procurement systems can significantly complicate the implementation of corruption schemes. Artificial intelligence can be used to process large datasets not only at the national level but also on an international scale, allowing for the tracking of cross-border corruption schemes.

The task of improving systems for conducting public procurement involves ensuring a balance between transparency, transaction processing speed, and confidentiality. According to O. Korniychuk & M. Hraf (2024) this creates unique challenges and requires careful consideration of both technological capabilities and legal requirements, particularly compliance with the General Data Protection Regulation (GDPR). The researchers emphasise the significant role of various cryptographic methods in addressing challenges related to ensuring privacy in blockchain systems, especially in the context of public procurement, where the demands for both transparency and confidentiality are simultaneously high. The implementation of blockchain technologies offers a comprehensive solution to privacy concerns in decentralised systems, paving the way for their development and application in the public sector. Implementing innovative technologies such as blockchain, artificial intelligence, predictive analytics, and big data has significant potential to enhance transparency, efficiency, and accountability in public finance management.

When selecting technological solutions, the government should consider both the advantages and potential risks. Proven centralised systems based on AI and big data can achieve quick results with limited resources, while exploring and piloting decentralised blockchain-based solutions like the Bitbon System can provide long-term transparency, security, and public trust.

Successful digital transformation in public finance management requires technological innovations and deep

institutional and cultural changes. The government must ensure political will, effective coordination among agencies, and stakeholder involvement (civil society, business, and experts) in reforms. A comprehensive and inclusive approach will make digital technologies effective in minimising corruption risks, enhancing public fund use efficiency, and restoring public trust in the public finance management system in Ukraine (Basiuk, 2024; Institute of legislative ideas, 2024). In public procurement, a blockchain-based system can record and monitor each stage, from the initial request for proposals to the awarding of contracts and tracking of deliverables.

Examining the potential of blockchain technology, M. Pournader *et al.* (2020) argued that blockchain can address privacy and transparency challenges inherent in procurement systems. Their study suggested that blockchain ensures data integrity and security, making it a valuable tool in public procurement. The current research corroborated this potential, highlighting the necessity for careful implementation to balance transparency with privacy concerns, especially considering GDPR compliance.

A key challenge remains the further digitalisation of all aspects of public finance, including implementing blockchain technologies to ensure data immutability and security. Blockchain can guarantee the transparency of transactions, as all transactions will be stored in a distributed system, which makes falsification or deletion impossible. This will be another step toward creating a system where corrupt activities become virtually impossible due to automation, transparency, and oversight (Köbis *et al.*, 2022).

The research conducted by E. Auriol *et al.* (2016) provided a foundational understanding of the efficacy of e-procurement systems in mitigating corruption within public procurement processes. Their findings demonstrate that e-procurement significantly curtails opportunities for corrupt practices by enhancing transparency and fostering competition. These insights are substantiated by the current research, which underscores the effectiveness of digital tools such as Prozorro and Dozorro in combating corruption in Ukraine. However, it is noteworthy that Ukraine faces unique challenges, particularly due to the ongoing war, which complicates the implementation and enforcement of anti-corruption measures.

In the context of developing countries, M.A.K. Masud *et al.* (2022) explored the role of transparency in reducing corruption. Focusing on Bangladesh, where corruption impedes economic development, scientists investigated the drivers behind anti-corruption disclosure (ACD) practices using firm-level data from financial sector companies listed on the Dhaka Stock Exchange. The study found that transparency initiatives, such as CSR expenditures, political corporate social responsibility (PCSR), financial constraints, internationalisation of reporting, and media visibility, significantly reduced corruption by enabling public scrutiny and accountability. These findings aligned with the current research, which highlighted that the transparency provided by Prozorro and Dozorro had been instrumental in identifying and addressing corrupt practices in Ukraine. Nonetheless, study of M.A.K. Masud *et al.* emphasised that transparency alone was insufficient and must be supported by robust legal and institutional frameworks, a point also underscored in the current study.

H. Habiburrochman *et al.* (2024) provided a global examination of various countries' strategies to combat corruption, focusing on technology, transparency, and accountability. While they offered a broad perspective, the current study zeroed in on Ukraine, evaluating digital tools like Prozorro and Dozorro during a turbulent wartime period. Both studies highlighted the power of blockchain, e-governance, and data analytics in reducing corruption. The current research concurred with H. Habiburrochman *et al.*, showcasing how Prozorro and Dozorro had improved transparency in Ukraine, with an eye on the potential of blockchain and AI. Both studies stressed the importance of policy reforms and international cooperation. H. Habiburrochman *et al.* advocated for anti-corruption agencies and stronger oversight, while the current study called for a comprehensive strategy combining legal reforms, digital tools, and public oversight. Ultimately, both studies converged on the notion that a multi-faceted approach – blending technological, cultural, and institutional reforms – was essential to effectively combat corruption. H. Habiburrochman *et al.* offered a global perspective, while the current study provided a detailed examination of Ukraine's specific context and successes with digital tools.

Another researcher in this field, H. Zhao *et al.* (2021), analysed the cultural impacts on e-government and corruption using data from 57 countries spanning the years 2003 to 2014. The current study employed a mixed-methods approach, analysing data from Prozorro and Dozorro in Ukraine (2020-2024), along with reports from NABU and SAPO. Both studies underscored the importance of digital tools. H. Zhao *et al.* found that e-government had a weak but positive impact on reducing corruption, influenced by cultural contexts. The current study, however, showed significant improvements in transparency and accountability in Ukraine through Prozorro and Dozorro, with the potential for further advancements through blockchain and AI.

In conclusion, the integration of digital solutions in public procurement presents a promising approach to combat corruption. However, the effectiveness of such tools is contingent upon their integration within a broader framework of legal, institutional, and policy reforms. The current research highlights the significant strides made in Ukraine through the use of digital tools like Prozorro and Dozorro, while also acknowledging the unique challenges posed by the ongoing conflict. The potential of blockchain and AI further underscores the need for a nuanced and multi-faceted strategy to effectively address corruption in public procurement.

Conclusions

This study examined the issue of corruption in Ukraine within a socio-political context, focusing on the effectiveness of digital tools like Prozorro and Dozorro in combating

corruption. The aim was to evaluate these tools' impact on transparency and accountability in public procurement, which was achieved.

The research employed a mixed-methods approach, integrating qualitative and quantitative techniques to analyse data from Prozorro and Dozorro systems from 2020 to 2024. Reports from NABU and SAPO, along with high-profile journalistic investigations, were also reviewed. The study found that despite the implementation of advanced digital initiatives, Ukraine continued to face reputational challenges due to ongoing corrupt activities. Digital tools such as blockchain and AI were identified as having significant potential to enhance transparency and efficiency in public procurement. The study also highlighted the complexities of combating corruption during wartime and emphasised the importance of international collaboration and public involvement.

The results underscored the necessity of a comprehensive strategy combining legal reforms, digital technologies, public oversight, and international cooperation to effectively combat corruption and build trust in public institutions. The findings demonstrated that while digital tools can significantly improve transparency and accountability, they must be part of a broader, multi-faceted approach to be truly effective. This research contributed to the understanding of how digital tools can be leveraged to combat corruption, offering valuable insights for policymakers and practitioners.

Limitations of the study included the lack of some published statistical information due to the ongoing war, which could have provided more precise results. Future research should explore the integration of digital tools with international anti-corruption frameworks, especially during wartime and post-war recovery. Additionally, investigating the role of public involvement and the effectiveness of various oversight mechanisms in different socio-cultural contexts is essential.

By fostering a culture of integrity and trust within public institutions, these efforts contribute to a more transparent, accountable, and fair procurement system, strengthening Ukraine's governance and enhancing its economic stability and attractiveness to foreign investors. This ensures efficient and responsible use of public funds, benefiting citizens and promoting sustainable development. Ultimately, these measures are crucial for building a resilient democracy where corruption is minimised, and public resources serve the public good.

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Conflict of interest

None.

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Цифрові рішення як ефективний підхід до боротьби з корупцією в сфері публічних закупівель

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Анотація. У цьому дослідженні розглянуто проблему корупції в Україні у соціально-політичному контексті. Наголошено, що попри впровадження цифрових інструментів, таких як Prozorro та Dozorro, країна продовжує стикатися з репутаційними викликами через тривалі корупційні прояви. Метою було дослідити, як цифрові рішення можуть стати ефективним інструментом у боротьбі з корупцією в процесах публічних закупівель, а також їхній потенціал у підвищенні прозорості, підзвітності та ефективності. У роботі застосовано комбінований методологічний підхід, що інтегрує якісні та кількісні методи для аналізу використання цифрових інструментів у боротьбі з корупцією в Україні. Було проаналізовано дані з систем Prozorro та Dozorro за період 2020–2024 років, а також звіти Національного антикорупційного бюро України і Спеціалізованої антикорупційної прокуратури та гучні журналістські розслідування, такі як Panama і Pandora Papers. Попри наявність передових цифрових ініціатив, Україна продовжує стикатися з репутаційними проблемами через постійні корупційні повідомлення. Дослідження виявило, що цифрові інструменти, такі як блокчейн та штучний інтелект, мають значний потенціал для підвищення прозорості та ефективності в системі публічних закупівель. У роботі також висвітлено виклики, що виникають у воєнний час, що підкреслює складність боротьби з корупцією за таких умов. Дослідження акцентувало увагу на важливості міжнародного співробітництва та залучення громадськості до нагляду за діяльністю органів влади. Зроблено висновок, що для зниження рівня корупції та формування довіри до державних інституцій необхідна комплексна стратегія, яка поєднує правові реформи, цифрові технології, громадський контроль та міжнародну співпрацю. Практична цінність цього дослідження полягає у розробці багатофункціонального антикорупційного підходу, що інтегрує зазначені ключові елементи для формування культури доброчесності та довіри в державних установах

Ключові слова: цифрові інструменти; прозорість; система публічних закупівель; Prozorro; методи боротьби з корупцією; блокчейн; антикорупційна політика