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Cloud Computing and Forensic Auditing Practices in Zimbabwe's Healthcare Sector

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Abstract
In Zimbabwe's healthcare sector, rising medical costs and insurance claims strain financial resources, worsened by hyperinflation and unemployment. Traditional auditing methods lack the sophistication to detect fraud effectively. Without cloud-based systems, managing and analyzing large financial datasets becomes difficult, limiting real-time fraud detection. This study explored how cloud computing enhances forensic auditing in the sector. Using a cross-sectional survey of 107 stakeholders, data were analyzed via SPSS for descriptive, factor, and regression analysis. Findings show cloud computing positively impacts audit effectiveness, despite challenges. The study offers insights for improving auditing practices. It also guides policy- makers on integrating cloud-based forensic auditing.

Keywords: Cloud computing, Forensic Auditing, Healthcare Sector

1. INTRODUCTION

Globally, rising healthcare costs have become a pressing issue, with many countries grappling with inefficiencies and fraud within their healthcare systems. In the United States, for instance, healthcare fraud is estimated to cost the system between 68 billion and 230 billion annually (Stowell et al., 2020; Moqbel & Wijesinghe, 2022). To combat these challenges, countries like the United Kingdom have implemented cloud computing solutions. The UK's National Health Service (NHS) launched the "Cloud First" policy, facilitating secure, centralised data storage that has enhanced audit capabilities and reduced administrative costs (Patel & Shah, 2023). Similarly, the U.S. Health Information Technology for Economic and Clinical Health (HITECH) Act promotes cloud-based electronic health records, thereby strengthening transparency and fraud detection (Moqbel & Wijesinghe, 2022).

In sub-Saharan Africa, healthcare systems face analogous obstacles, with the World Health Organisation (2022) reporting that approximately 40% of healthcare spending in the region is lost to inefficiencies, corruption, and fraud. For example, South Africa has experienced significant challenges related to billing fraud and ghost patients (Mantzaris, 2022). However, regional studies have predominantly focused on access to healthcare or supply chain issues, with limited attention given to fraud analytics or cloud-enabled auditing systems (Mamidala & Kumar, 2020). The absence of robust, integrated data systems has hindered effective analysis and prevention of financial irregularities, prompting calls for more advanced technological solutions.

In Zimbabwe, the healthcare sector has faced a steady increase in costs over the past two decades, driven by economic instability, inflation, and a heavy reliance on private healthcare services (Mangundu, Roets & ES, 2023). The economic crisis of the early 2000s severely weakened public healthcare infrastructure, resulting in limited regulatory oversight and inconsistent data collection (Chipunza & Nhamo, 2023). Consequently, many healthcare facilities began operating under conditions that fostered financial mismanagement and fraud (Muchena, 2019).

Traditional practices in Zimbabwean healthcare often rely on out-dated, manual, paper-based systems for record-keeping and financial reporting. These methods increase the risk of data errors and manipulation, complicating efforts to detect fraud, such as up-coding and billing for unrendered services. The Medical and Dental Practitioners Council of Zimbabwe (2023) reported that fragmented data and poor integration among healthcare providers have undermined the enforcement of ethical standards. Moreover, the lack of enforceable data governance policies has perpetuated siloed systems, limiting transparency and oversight (Leghemo et al., 2025).

The Association of Healthcare Funders of Zimbabwe (AHFoZ, 2023) has raised concerns regarding inflated claims and inconsistent pricing among providers. Due to many insurers operating outside AHFoZ's jurisdiction, regulatory enforcement remains weak, allowing unethical practices to thrive. These challenges highlight the urgent necessity for modern audit solutions. Cloud computing offers a promising response by enabling automated fraud detection, real-time monitoring, and enhanced data integrity through secure, encrypted storage and controlled access (Patel & Shah, 2023).

Despite numerous reforms and policy interventions, the Zimbabwean healthcare system continues to be plagued by financial mismanagement and corruption. Prior studies have identified governance failures, weak internal controls, and insufficient oversight mechanisms as contributing factors (Chikodzi & Nyoni, 2023; Chisunga et al., 2022). However, there remains a critical gap in exploring how modern technological solutions, particularly cloud computing, can enhance forensic auditing and fraud mitigation in the sector. Some initiatives, such as biometric systems for patient identification, have been introduced to minimize impersonation (Kumar et al., 2024). However, their effectiveness is limited to specific types of fraud and does not address complex issues like inflated billing and duplicate claims. These systems often function in isolation, lacking integration with broader healthcare data infrastructures, which hinders comprehensive auditing and the ability to trace anomalies across institutions (Kumar et al., 2024).

Recent studies have indicated the prevalence of overbilling and phantom billing practices in Zimbabwe's private healthcare sector (Dzimunya & Bhebhe, 2022). Yet, these studies have not sufficiently addressed the potential of technological interventions to combat such fraud. This oversight reflects a broader trend in the literature that underutilises digital technologies, particularly cloud computing, in addressing healthcare fraud. Given the increasing complexity and volume of healthcare data, the necessity for scalable and integrative fraud detection mechanisms is more urgent than ever (Narne, 2024; Karami & Jafari, 2025). Cloud computing capable of providing real-time analytics, secure data storage, and centralised information management represents a promising avenue for enhancing forensic auditing practices (Patel & Shah, 2023).

In response to these challenges and identified gaps, the present study titled "Cloud Computing in Forensic Auditing practices in Zimbabwe's healthcare sector" seeks to investigate the potential of cloud-based systems in enhancing forensic auditing practices addressing fraud in Zimbabwe's healthcare sector. Employing a quantitative method approach, this research explored the practical application and strategic integration of cloud computing tools in forensic auditing. The approach utilised structured surveys across selected healthcare institutions to assess the current use and potential of cloud technologies in auditing processes. Ultimately, the study aims to generate new insights that will inform the development of more transparent, accountable, and cost-effective forensic auditing practices. By bridging the critical knowledge gap regarding the application of cloud computing in forensic auditing, this research aspires to contribute to a more resilient and trustworthy healthcare system in Zimbabwe.

2. Research Methodology

The study made use of quantitative approach with a cross-sectional survey design. The study had a sample of 107 randomly selected stakeholders from the healthcare sector. A survey questionnaire was used for data collection with a scale that comprised of 15 items related to knowledge, ethics, effectiveness, collaboration, and technological integration. The survey was conducted using a scale designed to assess forensic auditing practices across various healthcare facilities in Zimbabwe. Data were analysed in SPSS for descriptive statistics, Exploratory Factor Analysis (EFA), and regression analysis. EFA identified underlying dimensions of forensic auditing practices, while regression analysis assessed the influence of cloud computing on these practices.

3. Results

3.1 Descriptive Statistics

3.1.1 Descriptive statistics for Cloud computing in Zimbabwe's healthcare sector

The results of descriptive statistics analysis for the aspects covered by cloud computing in Zimbabwe's healthcare sector scale are presented in Table 1. Descriptive statistics is the discipline of quantitatively describing the main features of a collection of information (Fisher & Marshall 2009). Descriptive statistics are a way of describing a distribution of data by reducing the data to a vital indicator of singular value to express information about the average of all observations. This section consists of 15 items used for ascertaining cloud computing in Zimbabwe's healthcare sector. The results are presented based on ranking of the mean, standard deviation and variance.

Table 1 Descriptive statistics for Cloud computing in Zimbabwe's healthcare sector

	Mean	Std. Deviation	Variance
1. I regularly use cloud-based applications in my daily work	6.20	.840	.706
2. My organisation plans to invest more in cloud technologies in the future	6.20	.905	.820
3. The subscription model of cloud services is financially beneficial	6.09	1.194	1.425
4. My organisation provides adequate training on using cloud computing	6.06	1.036	1.072
5. Cloud computing has increased my overall productivity	5.92	.675	.455
6. I believe that cloud computing will continue to grow in importance for	5.84	.992	.984

7. Using cloud services improves the efficiency of our operations	5.81	1.125	1.267
8. It is easy to upgrade or downgrade cloud services based on our	5.81	1.125	1.267
9. Technical support for cloud services is readily available when needed	5.77	.875	.766
10. Cloud computing enhances collaboration among team members	5.71	1.116	1.245
11. Access to cloud services improves my ability to work remotely	5.67	.510	.260
12. I believe that cloud computing is secure for storing sensitive data	5.56	1.083	1.173
13. Cloud computing offers my organization the flexibility to scale resources as	5.48	1.067	1.139
14. My organization has effective measures in place to protect data in the cloud	5.40	.834	.695
15. My organization has adopted cloud computing solutions	5.23	1.194	1.426

Based on the mean score of each item, respondents tend to agree that the healthcare sector in Zimbabwe has adopted cloud computing technologies in day to day operations. This is evidenced by the lowest (Mean (M) = 5.23, Standard Deviation (SD) = 1.19) for, 'My organization has adopted cloud computing solutions' and a highest (M = 6.20, SD = 0.84) for, 'I regularly use cloud-based applications in my daily work'.

3.1.2 Factor and reliability analysis for Cloud computing in Zimbabwe's healthcare sector

Exploratory Factor Analysis (EFA) and reliability analyses were done. Basically factor analysis is a data reduction tool that removes redundancy or duplication from a set of correlated variables (Hair et al. 2010). Exploratory factor analysis (EFA) was done on the aspects related to cloud computing in Zimbabwe's health sector. A principal component analysis with orthogonal (VARIMAX) rotations was assessed to identify underlying dimensions of cloud computing in Zimbabwe's healthcare sector. Results are shown in Table 2.

Table 2: Factor and reliability analysis for cloud computing in Zimbabwe's healthcare sector

Construct	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Cronbach alpha
Cloud computing in Zimbabwe's healthcare sector							.85

Adoption and Benefits of Cloud Computing	A2	.657				
	A5	.792				
	A6	.554				
	A10	.764				
	A12	.688				
	A15	.774				
Operational Efficiency and Support in Cloud Services	A4		.752			
	A9		.580			
	A11		.843			
Data Security and Remote Work Enablement	A7			.880		
	A13			.553		
Scalability and Future Growth of Cloud Computing	A8				.558	
	A14				.820	
Cloud computing solutions	A1					.895

Note: Items less than 0.5 were suppressed.

Among the 15 aspects covered by cloud computing in Zimbabwe's healthcare sector, 14 items had factor loadings above 0.50. The item with a low factor loading was deleted (A3). Components were labelled based on highly loaded items and the common characteristics of items they included. The component labels are 'Adoption and Benefits of Cloud Computing' (Factor 1), 'Operational Efficiency and Support in Cloud Services' (Factor 2), 'Data Security and Remote Work Enablement' (Factor 3), 'Scalability and Future Growth of Cloud Computing' (Factor 4) and 'Cloud computing solutions' (Factor 5). Reliability analysis indicates that the factors measured what they intended to measure with a Cronbach alpha score of 0.85. The remaining items were used for further statistical analysis.

3.2.1 Descriptive statistics for forensic auditing practices in Zimbabwe's healthcare sector

The results of descriptive statistics analysis for the aspects covered by forensic auditing practices in Zimbabwe's healthcare sector scale are presented in Table 3. This section consists of 15 items used for ascertaining forensic auditing practices in Zimbabwe's healthcare sector. The results are presented based on ranking of the mean, standard deviation and variance.

Table 3 Descriptive statistics for forensic auditing practices in Zimbabwe's healthcare sector

	Mean	Std. Deviation	Variance
1. I possess adequate knowledge of forensic auditing techniques	6.52	.664	.440
2. I adhere to high ethical standards in my forensic auditing practices	6.48	.692	.478
3. My investigation procedures are effective in uncovering financial discrepancies	6.47	.538	.289
4. Open communication enhances the effectiveness of forensic auditing in my organisation	6.45	.914	.835
5. My forensic audit reports are comprehensive and easily understood	6.38	.987	.974
6. I believe that clear documentation is essential during forensic audits	6.30	.849	.721
7. I follow a structured approach when conducting forensic audits	6.26	.883	.780
8. I regularly use advanced technology tools in forensic audits	6.16	.646	.418
9. I regularly update my knowledge of forensic auditing practices	6.09	.746	.557
10. Ethical considerations are prioritized during my audits	5.89	.731	.534
11. I feel confident in my ability to identify fraudulent activities through forensic auditing	5.85	.684	.468
12. My organisation values the role of forensic auditing in preventing fraud	5.77	.896	.803
13. Professional development opportunities in forensic auditing are readily available to me	5.75	.728	.530
14. I collaborate effectively with other departments during forensic audits	5.31	.464	.215
15. Forensic auditing significantly contributes to maintaining organisational integrity	5.31	.472	.222

Based on the mean score of each item, respondents tend to agree with the forensic auditing practices in Zimbabwe's healthcare sector. This is evidenced by the lowest (Mean (M) = 5.31, Standard Deviation

(SD) = 0.47) for, 'Forensic auditing significantly contributes to maintaining organizational integrity' and a highest (M = 6.52, SD = 0.66) for, 'I possess adequate knowledge of forensic auditing techniques.

3.2.2 Factor and reliability analysis for forensic auditing practices in Zimbabwe's healthcare sector

Exploratory Factor Analysis (EFA) and reliability analyses were done. Exploratory factor analysis (EFA) was done on the aspects related to forensic auditing practices in Zimbabwe's healthcare sector. A principal component analysis with orthogonal (VARIMAX) rotations was assessed to identify underlying dimensions of forensic auditing practices in Zimbabwe's healthcare sector. Results are shown in Table 4.

Table 4: Factor and reliability analysis for forensic auditing practices in Zimbabwe's healthcare sector

Construct	Item	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Cronbach alpha
Forensic auditing practices in Zimbabwe's healthcare sector							.70
Effectiveness and Ethics in Forensic Auditing	B3	.604					
	B5	.603					
	B9	.505					
	B11	.811					
	A13	.880					
Competence and Methodology in Forensic Auditing	B2		.818				
	B4		.725				
	B6		.670				
	B12		.656				
Collaboration and Organizational Support in Forensic Auditing	B8			.657			
	B15			.797			
Knowledge and Clarity in Forensic Auditing	B1				.651		
	B7				.713		

Ethical Standards and Contribution in Forensic Auditing	B10		.866
	B14		.630

Note: Items less than 0.5 were suppressed.

Among the 15 aspects covered by forensic auditing practices in Zimbabwe's healthcare sector, all items had factor loadings above 0.50. Components were labelled based on highly loaded items and the common characteristics of items they included. The component labels are 'Effectiveness and Ethics in Forensic Auditing' (Factor 1), 'Competence and Methodology in Forensic Auditing' (Factor 2), 'Collaboration and Organizational Support in Forensic Auditing' (Factor 3), 'Knowledge and Clarity in Forensic Auditing' (Factor 4) and 'Ethical Standards and Contribution in Forensic Auditing' (Factor 5). Reliability analysis indicates that the factors measured what they intended to measure with a Cronbach alpha score of 0.70. The remaining items were used for further statistical analysis.

3.3 Regression Analysis

Regression analysis was done to measure the objective. Regression analysis helps identify and quantify the relationships between variables, allowing the researcher to understand how one variable influences another. Cloud computing has 5 factors derived from factor analysis and forensic auditing practices also have 5 factors, hence 5 hypotheses can be derived (H_1a, H_1b, H_1c, H_1d and H_1e).

H_1a Cloud computing has a significant effect on Effectiveness and Ethics in Forensic Auditing

H_1b Cloud computing has a significant effect on Competence and Methodology in Forensic Auditing

H_1c Cloud computing has a significant effect on Collaboration and Organizational Support in Forensic Auditing

H_1d Cloud computing has a significant effect on Knowledge and Clarity in Forensic Auditing

H_1e Cloud computing has a significant effect on Ethical Standards and Contribution in Forensic Auditing

Results for regression analysis are shown in Tables below:

Table 5 Model Summary for H_1a

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.658[a]	.433	.411	.385	.433	19.503	4	102	.000

a. Predictors: (Constant), Solutions, Data security, Operational efficiency, Adoption and benefits

b. Dependent Variable: Effectiveness

These results indicate a moderate to strong positive correlation between the independent variables and the dependent variable (R = 0.658). A value closer to 1 suggests a stronger relationship. Approximately 43.3% of the variability in the dependent variable can be explained by the independent variables included in the model. This suggests that the model has a reasonable fit, but there is still a significant portion (56.7%) of variability unexplained, which may be due to other factors not included in the analysis. A p-value of less than 0.001 indicates that the model is statistically significant. This means that there is strong evidence to reject the null hypothesis and conclude that at least one of the independent variables has a significant effect on the dependent variable.

Table 6 Model Summary H_1b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.543[a]	.295	.267	.497	.295	10.662	4	102	.000

a. Predictors: (Constant), Solutions, Datasecurity, Operationalefficiency, Adoptionandbenefits
b. Dependent Variable: Competence

The regression analysis results for H_1b indicate a moderate correlation between the predictors and the outcome variable, explaining approximately 29.5% of the variability. The statistical significance of the F statistic suggests that the independent variables are meaningful contributors to the prediction of the dependent variable. However, since a large portion of variability remains unexplained, further investigation into additional predictors or variables is warranted to improve the model's predictive power. Overall, while the model shows promise, there are opportunities for refinement and enhancement in future analyses.

Table 7 Model Summary for H_1c

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.216[a]	.047	.009	.575	.047	1.248	4	102	.295

a. Predictors: (Constant), Solutions, Data security, Operational efficiency, Adoption and benefits
b. Dependent Variable: Collaboration

Regression analysis results for H_1c indicate a weak correlation between the independent variables and the dependent variable, explaining only 4.7% of the variability. The statistical insignificance of the F statistic and the low Adjusted R Square suggest that the independent variables do not effectively contribute to predicting the dependent variable. This indicates a need for further investigation, possibly considering additional relevant variables or alternative modeling approaches to enhance predictive power and better understand the factors affecting the dependent variable. Overall, the model shows limited effectiveness in its current form.

Table 8 Model Summary for H_1d

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.278[a]	.077	.041	.622	.077	2.138	4	102	.081

a. Predictors: (Constant), Solutions, Datasecurity, Operationalefficiency, Adoptionandbenefits
b. Dependent Variable: Knowledge

Results for H_1d indicate a weak to moderate positive correlation between the independent variables and the dependent variable. An R value of 0.278 suggests a slight tendency for the dependent variable to increase as the independent variables increase, but the relationship is not particularly strong. A p-value of 0.081 indicates that the model is marginally significant at the 0.10 level but not at the conventional 0.05 level. This suggests there may be some evidence that at least one of the independent variables has an effect on the dependent variable, but it is not strong enough to be conclusive.

Table 9 Model Summary for H_1e

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.190[a]	.036	-.002	.462	.036	.955	4	102	.436

a. Predictors: (Constant), Solutions, Datasecurity, Operationalefficiency, Adoptionandbenefits
b. Dependent Variable: Ethics

These results indicate a weak positive correlation between the independent variables and the dependent variable. An R value of 0.190 suggests that there is a slight tendency for the dependent variable to increase as the independent variables increase, but this relationship is very weak. Overall, the regression analysis results indicate a weak correlation between the independent variables and the dependent variable, explaining only 3.6% of the variability. The negative Adjusted R Square suggests that the model's predictors do not effectively contribute to explaining the dependent variable, and the high p-value (0.436) indicates that the model is not statistically significant. This suggests that the independent variables may not be relevant, and further investigation is needed.

Table 10: Summary of Hypotheses testing

Hypothesis	Hypothesized path	RSC	SFC	Remark
H_1a	CC→EEF	0.433	0.001***	Supported
H_1b	CC→CMF	0.295	0.001***	Supported
H_1c	CC→COF	0.047	0.295	Not Supported
H_1d	CC→ KCF	0.077	0.81*	Supported
H_1e	CC→ECF	0.036	0. 436	Not Supported

Note *p<0.10,**p< 0.05, *** p< .001
RSC = R Square Change
SFC = Sig F Change
CC = Cloud Computing
EEF = Effectiveness and Ethics in Forensic auditing
CMF = Competence and Methodology in Forensic auditing
COF = Collaboration and Organisational support in Forensic auditing
KCF = Knowledge and Clarity in Forensic auditing
ECF = Ethical standards and Contribution in Forensic auditing

As shown in Table 10, H_1a, H_1b and H_1d were found positive whereas H_1c and H_1e were not supported. Three of the hypothesised paths were, therefore, supported.

4. Discussion

This study sought to analyse the role of cloud computing in enhancing forensic auditing practices within Zimbabwe's healthcare sector. Cloud computing provides a centralised platform for storing and managing vast amounts of healthcare data, making it easier for forensic auditors to access and analyse information efficiently. Findings indicate a generally positive effect. The results indicate that cloud computing has a significant positive effect on forensic auditing practices. However two of the hypothesised paths were not

supported due to challenges that may be associated with the adoption of cloud computing.
Related studies noted the aspect of enhanced data accessibility and management as one of the primary benefits of cloud computing in as far as data storage and management is concerned (Aceto, Persico & Pescapé 2020; Sharma et al. 2023; Sachdeva et al. 2024). These studies note that, cloud computing provides a centralised platform for storing and managing vast amounts of healthcare data, making it easier for forensic auditors to access and analyse information efficiently. In essence, centralisation contrasts sharply with traditional on-premises systems, which often involve fragmented data silos that are difficult to navigate. Additionally, several other studies support this view. For instance, the studies highlight that cloud adoption results in a greater improvement in data accessibility (Aceto, Persico & Pescapé 2020; Sadoughi, Ali & Erfannia 2020). This enhanced accessibility enables auditors to quickly retrieve necessary information, reducing the time and resources required for investigations. Moreover, cloud-based systems often come with advanced search and filtering capabilities, further streamlining the data analysis process (Shrivastava et al. 2023).
Cloud computing also results in improved collaboration and real-time analysis within the healthcare sector. Cloud computing facilitates seamless collaboration among auditors, healthcare providers, and regulatory bodies (Atadoga et al. 2024; Bhardwaj et al. 2024). Forensic audits often require input from various stakeholders, and a cloud-based platform allows for real-time data sharing and communication. This can significantly expedite the investigation process and improve the accuracy of findings. Real-time data processing and monitoring are also crucial benefits. Cloud solutions enable auditors to promptly identify anomalies or fraudulent activities. This capability is particularly important in the healthcare sector, where timely detection of fraud can prevent significant financial losses (Elumilade et al. 2021; Karami & Jafari 2025).
The other two hypothesised path that were not supported may be attributed to observation by researchers on challenges and considerations related to the adoption of cloud computing for forensic auditing. Data security and regulatory compliance are major concerns. Healthcare data is highly sensitive, and any breach could have severe consequences. Therefore, it is essential to implement robust security measures, such as encryption and access controls, to protect patient information (Almulihi et al. 2022; Chen, Chou & Peng 2025). Another challenge is the dynamic and multi-jurisdictional nature of cloud environments. Data may be stored in different geographic locations, making it difficult to determine which legal framework applies (Ataei et al. 2018). Hence, forensic investigators must collaborate and rely on cloud providers to collect evidence for them, slowing down the forensic process. Overall, healthcare organisations need to develop clear policies and procedures for data governance and security, train forensic auditors in cloud-specific investigation techniques and ensure collaboration among all stakeholders to harness the full potential of cloud computing to improve transparency and accountability (Housawi & Lytras 2025).

5. Conclusion

Cloud computing emerged as a transformative tool for enhancing forensic auditing practices in Zimbabw--e's healthcare sector. The capacity for centralized data management improves accessibility and facilitates efficient data analysis for auditors. While the study indicates a generally positive impact, challenges such as data security and regulatory compliance must be addressed to fully leverage cloud technologies. Effective collaboration among auditors, healthcare providers, and regulatory bodies is crucial for real-time data sharing and prompt fraud detection, which are vital for minimizing financial losses. Developing clear policies, security measures, and training for auditors will further support the integration of cloud computing into forensic auditing, promoting transparency and accountability.

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