Challenges in Addressing the Ethical Aspects of Artificial Intelligence to Detect Fraud in Public Procurement Processes

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Abstract. *Public Procurement Processes (PPPs) involve substantial taxpayer money, necessitating efficiency and transparency. Artificial Intelligence (AI) is increasingly applied to fraud detection in PPPs, enhancing these processes. This work presents a literature review on AI's role in PPP fraud detection, focusing on ethical and technical challenges, including fairness, transparency, and privacy. We examine the global state of AI applications in PPPs, highlighting best practices and case studies. By analyzing these technologies' challenges and opportunities, we provide insights and propose strategies for mitigating risks, contributing to the debate on responsible AI adoption in the public sector.*

1. Introduction

Public Procurement Processes (PPPs) are related to the processes involved in tenders and establishing contracts for government acquisitions of services and products, representing a substantial portion of taxpayer money. However, around the world, fraud in PPPs has significant economic and social impacts, with global corruption costing over 5% of GDP in many countries [Ferguson 2018]. In the EU, PPP fraud accounts for 13-20% of the contract value, translating to 3-5% of GDP [Diaz 2017], with similar losses in Brazil potentially amounting to 1% of GDP [Fazio 2022]. Transparency, efficiency, and integrity are essential to prevent resource diversion and ensure fair contract awards that meet societal needs.

AI has been applied to fraud detection in PPPs in some works in the literature [Torres-Berru et al. 2023, Velasco et al. 2021, Mohd and Nohuddin 2021, Nai et al. 2023], but challenges like data quality and labeling persist [Soylu et al. 2022]. Beyond these aspects, there is still a need for addressing ethical aspects of AI in this scenario, as the impact of false negatives or false positives can be harmful to the many actors involved, including government institutions, private organizations, and, in the end, the citizens. This work discusses the challenges of addressing technical and ethical challenges in developing AI-based fraud detection solutions, offering insights and best practices for stakeholders. For this, Section 2 describes PPPs and some aspects in Brazil and Europe. Section 3 presents some works and discussions on applying AI to fraud detection. Section 4 presents a discussion on three key issues when applying AI to fraud detection in PPPs.

The issues in this work were identified through a combination of literature review and insights from past projects on AI in public procurement. The literature offered a broad view of global challenges, while discussions with auditors from Brazilian agencies, such as CGU and CADE, provided practical insights into the limitations and opportunities of AI locally.

2. PPPs

Public Procurement Processes (PPPs) can be divided into six main steps (Fig. 1). Identification: clearly identifying the objectives and scope of requirements to execute the PPP; 2. Scope: attending protocols to determine the right goods, services, and works to be bought or contracted at the end; 3. Method: defining if the tender will be open to all companies from the market or limited only to invited ones; 4. Notification: notifying the tender to the market to have as many participants as possible; 5. Evaluate: handling united errors and evaluating the proposals; and 6. Manage: managing contracts, from preparation to signing (or establishing a tender bond) with the winner of the tender.

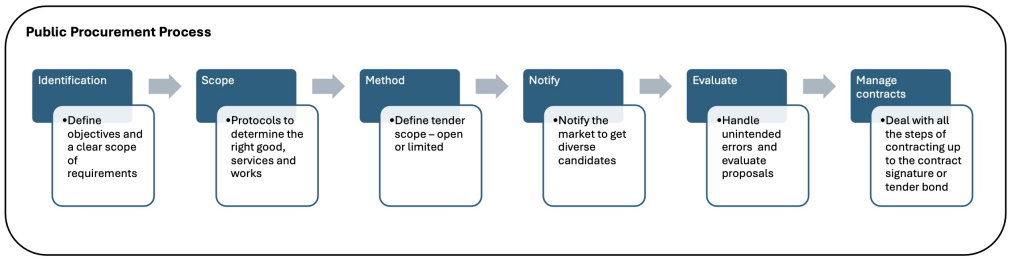

Figure 1. PPPs steps

Internationally, countries like the EU, Canada, South Korea, and Australia have integrated AI into their public procurement systems, enhancing transparency and reducing fraud. Organizations like the OECD support global cooperation by setting standards for fraud detection [Soylu et al. 2022]. In Brazil, despite a legal framework promoting transparency, the adoption of AI in PPPs remains limited due to technical, infrastructural, and regulatory challenges.

3. AI to fraud detection in PPPs

Traditional fraud detection methods, such as manual document reviews and audits, are time-consuming, error-prone, and often ineffective with large datasets [Brandão et al. 2024, Ezeji 2024]. In contrast, AI-based methods offer faster, more efficient fraud detection by analyzing large datasets and identifying patterns and anomalies. However, AI systems require high-quality training data and can raise concerns about fairness and transparency due to potential algorithmic bias.

Recent studies demonstrate the diverse techniques used to detect fraud in PPPs. For example, Torres et al. [Torres-Berru et al. 2023] utilized data mining and NLP techniques to detect favoritism and gender bias in Latin American procurement processes, achieving high accuracy. In Brazil, Velasco et al. [Velasco et al. 2021] developed a decision support system that identifies risk patterns in public contracts, improving public spending quality and aiding law enforcement. Other studies, like Mohd et al. [Mohd and Nohuddin 2021], applied advanced analytics in Malaysia to prevent corruption, while Nai et al. [Nai et al. 2023] used AI to automate PPP data analysis in Italy, identifying disputes in procurement.

Some discussions with auditors from Brazil's Office of the Federal General Controller (CGU) and the Federal Administrative Council for Economic Defense (CADE)

provided practical insights into the challenges of detecting fraud in procurement processes. Auditors highlighted the complexity of fraud schemes, the sophistication of perpetrators, and the limitations of current detection systems, emphasizing the need for ongoing system evolution to address increasingly intricate fraudulent activities. However, collecting and turning available data related to PPPs remains a challenge.

In this way, although AI holds significant potential for fraud detection in PPPs, its integration must be approached with caution to ensure reliability, accuracy, and transparency related to both the data used in the fraud detection process and the models generated to this end. There is also a need for further exploration of hybrid methods that combine supervised and unsupervised approaches and adaptation of methods to different cultural and regulatory contexts.

4. Key Issues on Fraud Detection in PPPs through AI

The growing complexity of fraudulent activities in PPPs necessitates a multi-faceted approach to fraud detection that integrates advanced technologies like AI. However, addressing ethical, technical, and practical challenges is yet a challenge. Key issues include data quality, reliable ML model development, and the essential role of human oversight in validating automated decisions.

Data quality is fundamental for guaranteeing data privacy, one ethical aspect of AI. AI-driven fraud detection depends on high-quality, complete data, as any compromise can reduce model effectiveness. Also, there are many works in the literature that tackle fraud detection as a supervised learning task. In this way, there is a need for large, labeled datasets, which are often scarce in PPP contexts due to the complexity of defining if such a PPP is fraudulent and in which part. Addressing these challenges requires robust data governance and collaboration among experts and stakeholders.

The reliability of ML model development is another key issue, as it is directly related to transparency and fairness. We could observe that many sophisticated models are needed to identify complex and evolving fraud patterns, as different works tackle the fraud detection problem in PPPs with diverse manners, looking into specific aspects of PPPs. However, the interpretability and explainability of the models are crucial for user trust or the transparency aspect of ethical AI. For instance, indicating the rationale of the used models to the user, or at least indicating which were the main features used to indicate if a case is fraudulent, are essential in this scenario. Also, considering the constant evolution of fraud tactics necessitates regular model updates, requiring a strong infrastructure for data collection, labeling, and ongoing model validation. Fairness is directly associated with these aspects. In this way, a well-managed lifecycle to properly manage both data and models is vital to maintaining the effectiveness of ML-based fraud detection.

Last but not least, human oversight remains crucial in assessing AI model outputs, ensuring decisions are contextually appropriate and ethically sound. Transparency and explainability are key to making ML-driven decisions fair, reliable, and socially responsible, protecting individual rights and upholding ethical standards. Also, critically analyzing the impacts on the actors involved that can be affected when there is a false positive or a false negative fraud detection remains a challenge.

5. Conclusion and Future Works

The application of AI in fraud detection in PPPs has the potential to mitigate the negative economic and social impacts of corruption. However, AI models can introduce biases and obscure decision-making, making interpretability and accountability crucial, especially in public government. Ensuring the ethical use of AI remains challenging, as it requires addressing issues related to fairness and transparency. Addressing these challenges requires not only technical advancements but also strong ethical frameworks to guide the responsible use of AI in public procurement.

Future work may focus on mapping risk factors in the use of AI in government. We specifically aim to focus on explainability and interpretability in this process although all the other ethical aspects mentioned in this work are also important.

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