Enhancing Contract Management through Natural Language Processing(NLP): A Case Study of Three African Countries

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Abstract

This study explores how Natural Language Processing (NLP) has transformed contract management, enabling businesses to interpret government contracts more accurately and quickly. The research involved extracting data from African public procurement portals of three African countries which are Morocco, Ghana, and Benin, and applying NLP techniques for language translation and keyword extraction. The results demonstrate the potential of NLP in transforming contract management, providing valuable information for informed decision-making, and promoting transparency and accountability with government spending. This study serves as a practical demonstration of NLP's application in contract management and suggests future research opportunities for expanding its use in other African countries

1 Introduction

1.1 Background and significance of contract management

Contract management plays a vital role in various sectors, including government procurement. It involves the administration, negotiation, and monitoring of contracts to ensure compliance with terms and conditions, mitigate risks, and optimize outcomes. Government contracts, in particular, are critical as they involve taxpayer funds and impact the delivery of public services and projects. Government contract management involves complex processes and challenges. Government agencies must navigate stringent regulations, adhere to transparency and accountability standards, and manage large volumes of contracts with diverse stakeholders

1.2 Natural Language Processing's (NLP) Increasing Contribution to Contract Management

NLP can be integrated with advanced technologies to process unstructured data and improve human-computer interaction, leading to meaningful outcomes that enhance decision-making and improve operational efficiency in various industries (Bahja, 2020). Indeed, NLP methods have proven to be effective for managing unstructured text data, such as maintenance requests in buildings (Bouabdallaoui et al., 2020). Furthermore, in different sectors like healthcare, NLP has shown its prowess as an effective technique for detecting a broad range of adverse events in text documents, outperforming traditional and other automated methods (Melton Hripcsak, 2005). Additionally, the advent of machine learning techniques within NLP can analyze qualitative data almost instantaneously, proving valuable for qualitative researchers, guiding their creation of codebooks (Leeson et al., 2019). Natural Language Processing (NLP) has grown significantly in importance in contract management

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over the past few years. Advanced contract analysis and insight extraction capabilities are provided by NLP technologies, which also streamline contract interpretation and automate time-consuming human tasks

1.3 Research objective and scope

Mtasigazya (2018) indicated that key problems to contract management and enforcements are corruption, collusion between local government officials and private companies, and poor monitoring of private companies. Notably, Heald (2012) argued that the structure of transparency mechanisms profoundly influences their impact on public policy, affecting not just efficiency, but also equity and democratic accountability. In this context, this study aims to explore the potential of NLP technologies in contract management, focusing on government contracts in Morocco, Ghana, and Benin. The central objective is to enhance accuracy, efficiency, and transparency in managing public contracts through NLP analysis of data from African public procurement portals. Specifically, the study endeavors to demonstrate how NLP can facilitate transparency in government spending, possibly reshaping the efficiency and equity in public policy as suggested by Heald.

2 Methodology

The research methodology was organized systematically, starting with data extraction from public procurement portals of Morocco, Ghana, and Benin using tailored Python scripts that integrated web scraping tools like Beautiful Soup and Selenium Webdriver. Once the raw data, consisting of tenders, was collected, a normalization step was conducted to ensure consistency. Given the bilingual nature of the dataset, with some tenders being in French, specific Natural Language Processing (NLP) modules were employed to translate the unstructured contract data into English, emphasizing the use of sophisticated techniques like sequence-to-sequence models and attention mechanisms. To distill the essence of these tenders, the Gensim library was deployed, leveraging its capabilities for keyword extraction from extensive texts, with methods like TF-IDF and Latent Dirichlet Allocation. Following the extraction process, a series of exploratory data analysis techniques were applied to present the raw and extracted data into structured insights, including various visualizations that elucidated trends and patterns in the data. This comprehensive and meticulous approach was designed to ensure both the accuracy and efficiency of data processing, aligning the research with its core objective of exploring the transformative potential of NLP in contract management.

3 Results and Findings

In the following subsections are some of the insights generated from the study

3.1 Some analysis of the extracted data from the Moroccan public procurement portal in 2022

Figure 1 shows that 41% of the contract awarded were for Services while Public Work and Furnitures account for 39% and 20% respectively. While figure 2 shows Rabat ,Casablanca and Marrakech accounts for the top three locations with contracts awarded.While Province d'Al Hoceima and Province de Sidi Kacem are least awarded contracts

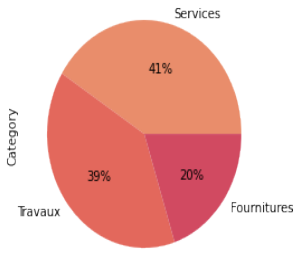

Figure 1: Entry title

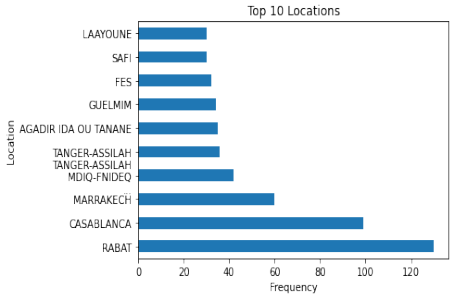

Figure 2: Location

3.2 Some analysis of the extracted data from the Ghanaian public procurement portal in 2022

Figure 3 shows Bekwai Municipal Hospital has won the most contracts in the health sector in Ghana while figure 4 shows that Essential medicines accounts for 16.8% of all contracts awarded in Ghana and it can be seen that the contract entries for Ghana is very competitive hence the lower percentages.

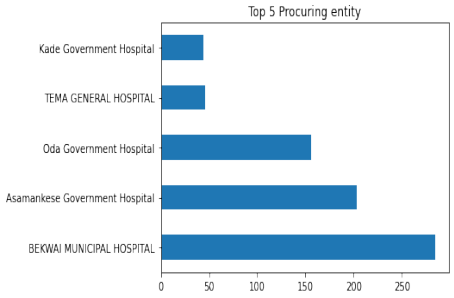

Figure 3: Procuring Entry

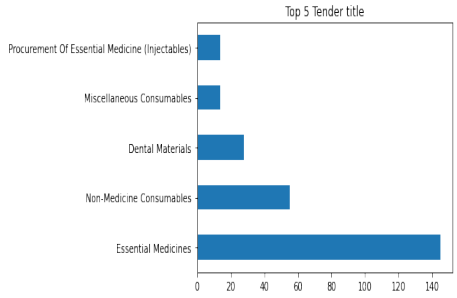

Figure 4: Entry titles

3.3 Some analysis of the extracted data from the Benin public procurement portal in 2022

Figure 5 shows offers closed in 2022, 89 closed in November, 68 in both July and October.Among the 9 offers that will be closed in 2023, three will be in May and two in March while figure 6 shows the main authority having launched the calls for tenders is SBEE, the electricity company in Benin. In the top 10 we also found the Port and the agency in charge of agricultural mechanization

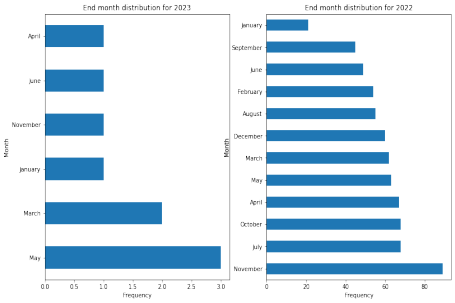

Figure 5: End month/year

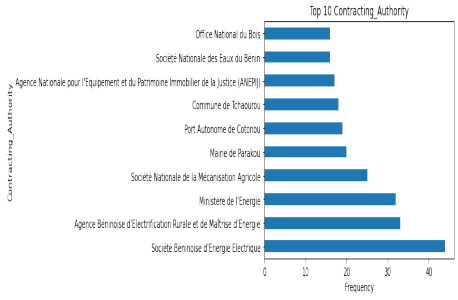

Figure 6: Top Contracting authority

3.4 General insights

The offers are mainly launched by medical structures in Ghana, by electrical structures in Benin.In Morocco, the offers are mostly services. The offers are often launched in the middle of the year: not at the very beginning nor completely at the end. In Morocco, offers last an average of 139 days. Very few of the offers launched in 2022 will be closed in 2023

4 Implications and Benefits

The implications and benefits of applying Natural Language Processing (NLP) in contract management are manifold. Firstly, NLP has the potential to promote transparency and accountability in government spending by providing efficient contract analysis and monitoring mechanisms. This ensures that public funds are utilized judiciously, fostering public trust in government activities. Secondly, NLP enhances decision-making for both businesses and governments by extracting key contract information, such as pricing and deliverables, enabling more informed choices. Finally, NLP reduces information asymmetry, enabling transparent decision-making processes and empowering stakeholders with comprehensive insights into contract details. These advantages collectively underscore the transformative impact of NLP in contract management, facilitating efficient resource allocation and enhancing overall contract management practices.

5 Practical Applications and Future Directions

The practical applications of Natural Language Processing (NLP) in contract management within the three African countries (Morocco, Ghana, and Benin) offer valuable insights. NLP can streamline contract interpretation, enhance accuracy, and automate key processes, benefiting government agencies and businesses alike. Moreover, these successful applications pave the way for expanding NLP adoption in other African countries and diverse sectors. Future research directions may explore fine-tuning NLP models for specific contract types, optimizing multilingual NLP for diverse African languages, and integrating NLP with other emerging technologies for comprehensive contract management solutions. However, potential challenges, such as data privacy concerns, language complexities, and ensuring model interpretability, require careful consideration to harness NLP's full potential in transforming contract management practices across the African continent.

6 Conclusions

In conclusion, this research on the transformative potential of Natural Language Processing (NLP) in contract management has yielded significant findings and valuable contributions. The study demonstrated the efficacy of NLP in enhancing contract accuracy, efficiency, and transparency, benefiting government agencies, businesses, and the public. By automating contract analysis, extracting crucial information, and enabling informed decision-making, NLP emerges as a powerful tool for improving contract management practices. The implications of this research extend beyond cost savings and operational efficiency, emphasizing the promotion of transparency and accountability in government spending. NLP's transformative potential in contract management underscores its value in driving efficient resource allocation and fostering trust in public institutions. As future research explores advanced NLP applications and addresses potential challenges, the transformative impact of NLP in contract management is poised to revolutionize governance, business practices, and service delivery across industries and continents.

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