Open Access Library Journal
2025, Volume 12, e13277
ISSN Online: 2333-9721
ISSN Print: 2333-9705

Implementation of an Intelligent System of Audit Recommendations in Congolese Public Companies

Lukusa Muvuala Vicky[1], Bertin Mazunze[1], Kabango Dyuba Desiré[2]

[1]Department of Computer Science, Lubumbashi Higher Institute of Commerce, Lubumbashi, Democratic Republic of the Congo
[2]Department of Computer Science, ISP MITWABA, Mitwaba, Democratic Republic of the Congo
Email: vicmuvuala@gmail.com

How to cite this paper: Vicky, L.M., Mazunze, B. and Desiré, K.D. (2025) Implementation of an Intelligent System of Audit Recommendations in Congolese Public Companies. *Open Access Library Journal*, **12**: e13277.
https://doi.org/10.4236/oalib.1113277

Received: March 15, 2025
Accepted: May 19, 2025
Published: May 22, 2025

Abstract

This study addresses the inefficiencies of audit processes in Congolese state-owned enterprises by proposing an intelligent system of recommendations. Leveraging artificial intelligence (AI), natural language processing (NLP), Unified Process (UP), and blockchain technology, this system automates data analysis, ensures transparency, and strengthens the implementation of audit recommendations. The use of advanced tools, including UML for system modeling and GPT for linguistic analysis, enhances the robustness of the system. The results show significant improvements in speed, accuracy and resource management in public audit processes, providing a roadmap for modern governance in the Democratic Republic of Congo (DRC).

Subject Areas

Information Management

Keywords

Audit recommendations, Artificial Intelligence, Natural Language Processing, Blockchain, Governance, Public Enterprises, DRC, UP, UML, GPT

1. Introduction

Congolese state-owned enterprises play a decisive role in the country's economic and social development. They are responsible for providing essential services such as energy, clean water, and transportation, contributing to the well-being of citizens and national growth.

Indeed, the advent of the digital revolution has profoundly changed many sectors of activity, and auditing is no exception [1]. However, these companies face many challenges, particularly in managing their audit processes. Today's society is constantly evolving. Today, one of the main trends impacting the world is digitalization [2]. Although audits are a crucial tool for assessing the management and use of public resources, the methods currently in place in these companies often rely on manual and human processes.

The latter, although necessary, has several limitations that hinder the reliability of the results. Among these weaknesses, the subjectivity of the listeners is a major problem. It can be influenced by external factors such as political pressure, corruption or conflicts of interest. In addition, the slowness of audit processes, coupled with sometimes inappropriate data management, prevents effective follow-up of recommendations, thus limiting their impact on the improvement of the management of public companies.

Faced with these challenges, this research proposes to explore the introduction of modern technological solutions, in particular artificial intelligence (AI), as a response to improve the quality and efficiency of audits in Congolese public enterprises.

1.1. Problem

Audits play a fundamental role in identifying dysfunctions within public enterprises and in guiding them towards the necessary improvements. In an increasingly digital world, audit practices are evolving to incorporate artificial intelligence (AI) technologies, improving audit efficiency and accuracy while managing new associated risks [3].

In the Democratic Republic of Congo, where state-owned enterprises are major players in strategic sectors such as energy, water or transport, audits should be powerful levers to ensure transparent and efficient management of public resources. However, in the current context, there are several challenges that limit their real impact.

On the one hand, there are many cases where audits do not even make recommendations, or those that are issued do not always adequately address the weaknesses identified, especially due to the human limitations of the auditors. The subjectivity of auditors, influenced by personal biases, conflicts of interest or even corruption, can lead to recommendations that are not sufficiently adapted to real problems. On the other hand, even when relevant recommendations are made, they are often ignored or poorly followed, due to slow processes, inefficient data management, or a lack of rigorous monitoring mechanisms.

To respond to these issues, this work examines:

Ways to improve the quality and relevance of audit recommendations in Congolese state-owned enterprises.

The role that the auditor can play in a system enriched by artificial intelligence.

Strategies to ensure that AI-generated recommendations accurately meet the needs of businesses.

1.2. Assumptions

To answer the problem, this research formulates the following hypotheses:

The implementation of an intelligent system, integrating natural language processing (NLP) tools, will improve the quality, relevance and implementation of audit recommendations in Congolese public companies. This assumption is based on the idea that the use of artificial intelligence (AI) and NLP will automate the analysis of audit reports, internal documents, and textual data, making recommendations more accurate and responsive to the issues identified. With its in-depth analysis of the data, the system could overcome human bias, speed up the audit process, and offer more reliable recommendations, making it easier to implement them effectively. AI algorithms can quickly analyze large volumes of financial data, identify patterns, and detect anomalies or potential fraud [4].

The intelligent system will not completely replace the auditor in his or her duties, but rather serve as a complementary tool to improve its efficiency and help it make more relevant recommendations. This hypothesis explores the idea that artificial intelligence, while effective at processing and analyzing large volumes of textual data, will not be able to completely replace the human function in audits. The auditor, with his or her contextual expertise, will continue to be indispensable in interpreting the results provided by the system, validating the recommendations and applying them in an appropriate strategic framework. AI will therefore act as a decision-making tool, providing valuable information.

To ensure that audit recommendations provided by artificial intelligence (AI) are not compromised by a corrupt auditor, we propose that blockchain technology could be used to record all recommendations generated by the AI system, creating a non-modifiable and transparent ledger that prevents any manipulation of recommendations after they have been generated. Here, NLP allows AI systems to understand and process human language. Auditors can use NLP to extract relevant information from contracts, financial statements, and other textual documents, making data analysis more efficient [4].

2. Materials and Methods

The design of an intelligent system for audit recommendations in Congolese state-owned enterprises is based on a strategic combination of material and intangible resources and innovative methodologies. This section presents the tangible and intangible elements that make up the project and their respective roles in achieving the objectives.

2.1. Materials

The hardware infrastructure is the foundation on which the performance and reliability of the system is built. Here is the main equipment used.

2.1.1. Physical Hardware

Physical hardware is the basis for developing and testing our solution. They include:

1) Local workstations

These high-performance computers allow you to develop, simulate, and test the system's functionalities locally. The recommended configurations are:

- **Processor**: Intel Core i5 or i7 (or equivalent).
- **Random Access Memory (RAM):** 8 to 16 GB to handle AI-related loads.
- **Graphics card**: NVIDIA RTX 3060 or better to accelerate workouts and heavy calculations.

2) **Internet connection**

A stable connection, via a high-performance modem or router, is required to interact with online services such as the GPT-4 API and Firebase, and to ensure smooth data synchronization.

2.1.2. Hardware, Software and Templates

Immaterial tools include the models, libraries, languages, and development environments used in the design of the system.

The GPT-4 model, is the fourth-generation language model of the GPT series, developed by OpenAI, which promises significant advances in the field of natural language processing (NLP) [5]. This model is the main driver of the audit recommendation system. This choice is based on its advanced capabilities in natural language processing (NLP), but also on the specific modifications made to meet the particularities of audits in Congolese public companies.

In the framework of this study, the GPT-4 model was not used in its standard version, but was adapted to correspond to the needs and realities of the Congolese context:

- **Localized training**: The model was refined using Congolese audit reports, incorporating technical terms, local standards, and cases specific to state-owned enterprises. This approach has made it possible to develop a tool capable of understanding and interpreting the particularities of local data.
- **Prioritization of recommendations**: Algorithms have been adjusted to rank recommendations according to their relevance and potential impact, allowing auditors to focus on the most critical actions.

Thanks to the adjustments made, the model can provide recommendations tailored not only to public companies, but also to specific sectors.

The integration of the GPT-4 model plays a decisive role in achieving the objectives of our research, through:

- **Analysis of audit reports:** GPT-4 will make it possible to read and analyze the textual data present in the reports. Thanks to his extensive training, he will be able to identify key points, identify non-conformities and detect any inconsistencies.
- **Intelligent recommendation generation:** The model will automatically produce audit recommendations based on the analysis performed. These recommendations will be contextualized, relevant and adapted to each situation.
- **Automation of decision-making processes**: By replacing manual and repetitive tasks, GPT-4 will speed up audit processes, reduce human error, and in-

crease team productivity.

- **Scientific reliability:** As this model is produced by a renowned company like OpenAI, GPT-4 benefits from extensive scientific validation. It is recognized for its high performance in tasks requiring semantic analysis and advanced text understanding.

The objective of this research, from a technical point of view, was to refer to the chatGPT model, then create our own personalized model for audit recommendations in Congolese public companies. For those who are not familiar with chatGPT, let's remember that: ChatGPT is a pre-trained AI model designed to engage in natural language conversations, using sophisticated natural language processing (NLP), supervised learning, and reinforcement learning techniques to understand and generate text comparable to human-generated text [6].

To design a smart system that can address the complex challenges of audits in Congolese state-owned enterprises, we have carefully selected a set of technologies and tools. These choices were not insignificant: each tool was integrated taking into account its ability to improve the efficiency, reliability and adaptability of our solution, because the creation of quality applications is associated with a significant development effort, an effort that must be continued for maintenance as long as the application is in production [7].

We chose Flutter and its native Dart language to develop the system. This choice was made by their effectiveness in creating modern, cross-platform user interfaces. Flutter allowed us to design a homogeneous application that works on mobile as well as on web and desktop. Dart, on the other hand, proved to be particularly suitable thanks to its simplicity and speed of execution. This combination provided a solid foundation to ensure a smooth and professional user experience while meeting the specific needs of auditors.

To meet our data analysis and user interface needs, we have integrated several essential libraries. Among these, the OpenAI library played a key role. It enabled seamless communication with the GPT-4 API, turning audit reports into intelligent, actionable recommendations. The libraries of Flutter and Dart have been leveraged to customize the user interface and ensure optimal ergonomics. Thanks to these tools, we were able to offer a high-performance application, adapted to the expectations of users, and scalable according to future needs.

Data management in an intelligent system cannot be left to chance. For this, we chose Firebase as our data management platform. Firebase isn't just a storage tool: it's a central player in information security and traceability. Firebase is a platform for developing applications for the web or for mobile. It provides tools as a service for building mobile apps [8]. Each audit recommendation is securely backed up with a detailed history of changes. This not only ensures full transparency, but also protects against unauthorized access or alteration. Firebase has also made it easy to sync data in real-time, a critical feature for collaborative audits.

2.1.3. Customization of the GPT-4 Model for the Congolese Context

The customization of the GPT-4 model was carried out through a contextual finetuning approach combined with prompt engineering. First, a local corpus was created using actual audit reports from several Congolese state-owned enterprises. These documents were anonymized and classified by type of recommendation, relevant domains (finance, human resources, governance, etc.), and levels of criticality.

Since the GPT-4 model was not trained from scratch, we used an intelligent prompting system that dynamically structures queries sent to the AI by incorporating local elements: Congolese technical terminology, references to OHADA standards, the Public Procurement Code, and internal regulations specific to certain state-owned enterprises.

The algorithms were also adjusted to prioritize recommendations based on:

- their potential impact on company performance,
- their short-term feasibility,
- their urgency level in relation to compliance.

This customization enables the generation of non-generic, relevant, and directly actionable recommendations for auditors within the Congolese context.

2.2. Methods

The importance of a method is all the greater in our project, where the precision, objectivity and traceability of recommendations are paramount, hence in this section we will detail the methodological approach adopted for the development of our intelligent system of audit recommendations.

The development process defines a sequence of steps, in ordered parts that contribute to the development of software or the evolution of an existing system. The purpose of a development process is to produce quality software that meets the needs of its users over time and at predictable costs [9].

To develop and implement an intelligent system of audit recommendations in Congolese state-owned enterprises, we have adopted a rigorous methodology based on a combination of iterative principles and advanced technologies. The approach adopted is based on the customization of artificial intelligence tools, the structuring of software development and the integration of relevant data using the UP method and the UML modeling language.

To structure this phase, we organized the modeling into three main parts: business system analysis, system requirements modeling, and system architecture. These steps allow for a thorough understanding of the field, a clear definition of functional objectives, and a robust engineering design.

2.2.1. Business System Analysis

This initial phase consisted of an in-depth study of the existing processes in the audits of Congolese public companies. The objective was to understand:

1) Current workflows: Identification of critical audit milestones, stakeholders involved, and existing gaps (e.g., lack of follow-up on recommendations).

2) User needs: Collection of the expectations of auditors, managers and decision-makers regarding **the** functionalities of the system.

3) Contextual constraints: Integration of the specificities of public companies, such as local standards and business practices.

This analysis served as a basis for identifying opportunities for automation and areas where artificial intelligence, particularly GPT-4, could add value.

2.2.2. Design of the New System

This phase allowed us to engineer the requirements of the current system and facilitate us in designing the new system. System engineering is a general methodological approach that encompasses all the activities appropriate to design, evolve and verify a system that provides an economical and efficient solution to a customer's needs while satisfying all stakeholders [10]. After the business analysis, we used UML to model the system requirements. This step translated the needs of users into actionable technical specifications. Here are the key elements of this design with the UP and UML method in our audit recommendation system.

A) Table of actors

An actor represents a role played by an external entity (human user, hardware device, or other system) that interacts directly with the system under study [11].

Here is a table describing the actors of your audit recommendation management project:

Table 1. Table of actors presents the different categories of users or systems involved in the audit recommendation management process.

No.	Actor	Description
1	Audit Manager	The auditor is responsible for analyzing the audited entity's data and practices.
2	Audited	The entity or department subject to the audit.
3	Managing director	The Director General oversees the audit process at the strategic level.
4	AI Virtual Assistant	The AI Virtual Assistant is an intelligent system that guides auditors through the audit process.
5	Administrator	The person responsible for managing user accounts.

B) New system context diagram

The context diagram allows us to describe the interactions between the system we are designing and its environment. This diagram shows the system and the entities in the environment with which it relates [12].

The image below shows the context diagram of our new intelligent audit recommendation system.

As shown in Figure 1, the context diagram of our new intelligent audit recommendation system illustrates the flow of information between the users (actors) and the central system. It helps visualize the system boundaries as well as the input and output points for data.

C) Use case identifications

A use case represents a service offered by the system to one or more actors in its environment. It is defined by a function in an ellipse related to the actor concerned [13].

As part of our intelligent system for audit recommendations (Table 1), a use case corresponds to a structured set of sequences of actions carried out by the system in order to produce an observable and relevant result for a given actor. These use cases help identify the key features that the system needs to accomplish to meet the needs of the actors involved.

As shown in Table 2, the following use cases have been identified in our intelligent audit recommendation system.

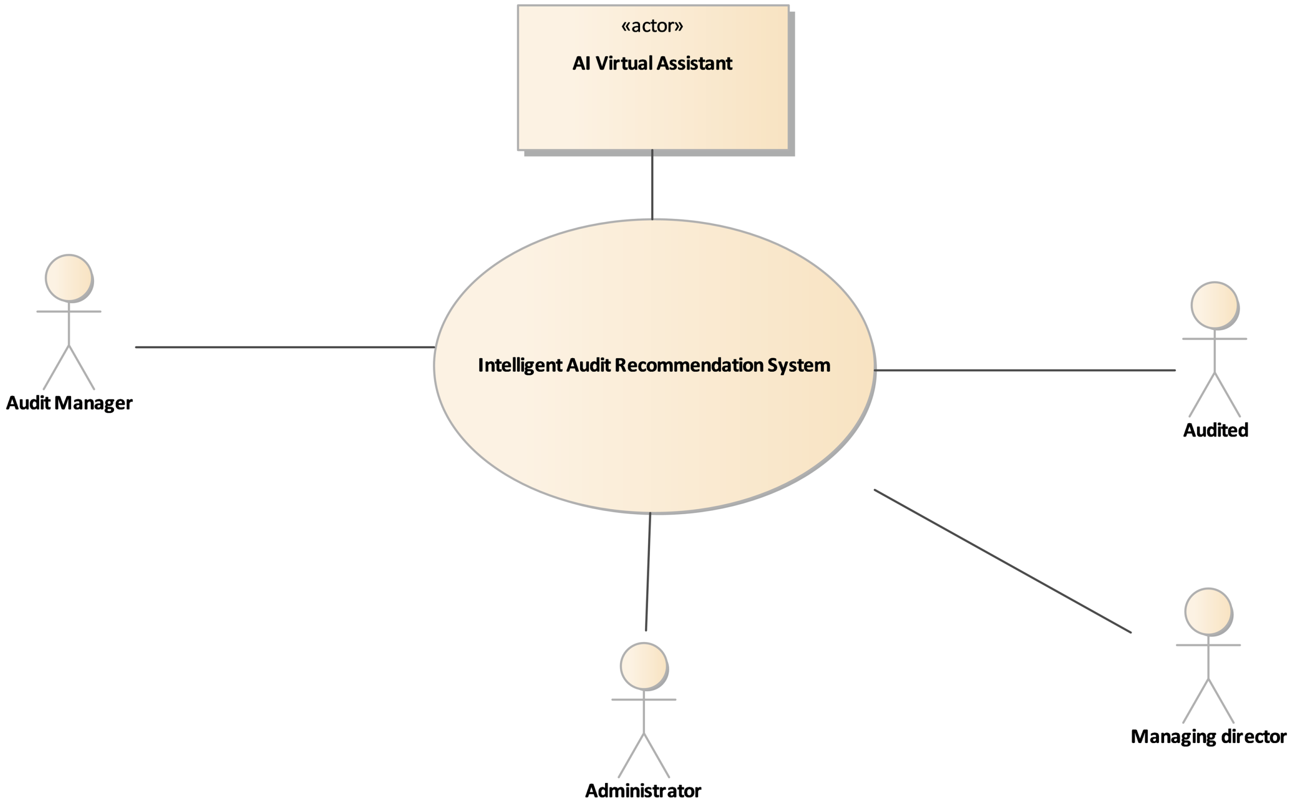

Figure 1. New system context diagram.

Table 2. Use case identifications.

No.	Use case	Description
1	Authenticate	Allows users (auditor manager, audited, general manager) to log in to the system with secure credentials.
2	Announce the audit	This use case allows the author to announce the audit to the auditees.
3	Submit data	This use case allows auditees to provide all the necessary information to auditors.
4	Analyze the data	This use case allows AI to do the auditing.
5	Make recommendations	This use case allows AI to automatically generate recommendations based on the data analysis performed.
6	Generate the audit report	This use case allows the AI to generate the audit report.
7	Manage users	This User Case allows the administrator to manage system users.

D) Use case diagram

A use case diagram lists the usage functions that the system offers to each of its user actors in order to meet their needs. It must not specify how it provides these services. [13]

The use case diagram helps describe the customer's needs in the system and the system's requirements for the customer. The use case diagram, shown in Figure 2, summarizes the services that the system offers to its various actors.

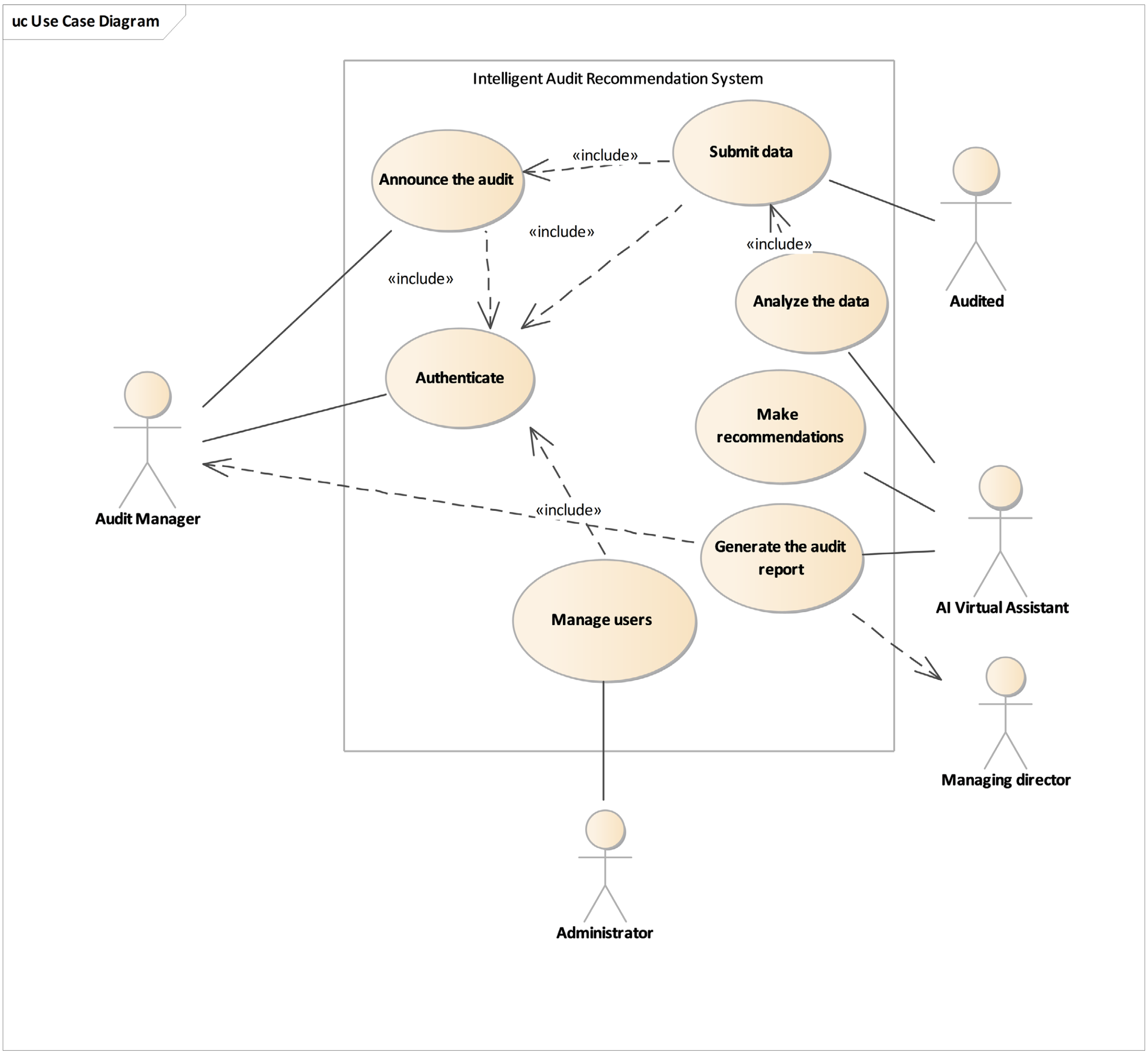

Figure 2. Use case diagram.

E) Class diagram

The class diagram is used to model the static structure of the system. It shows the different classes, their attributes, their methods, as well as the relationships between them. This diagram helps you understand the dependencies and interactions within the intelligent audit recommendation system.

As shown in Figure 3, the class diagram of our system illustrates the main classes and how they relate to each other to support the audit recommendation process.

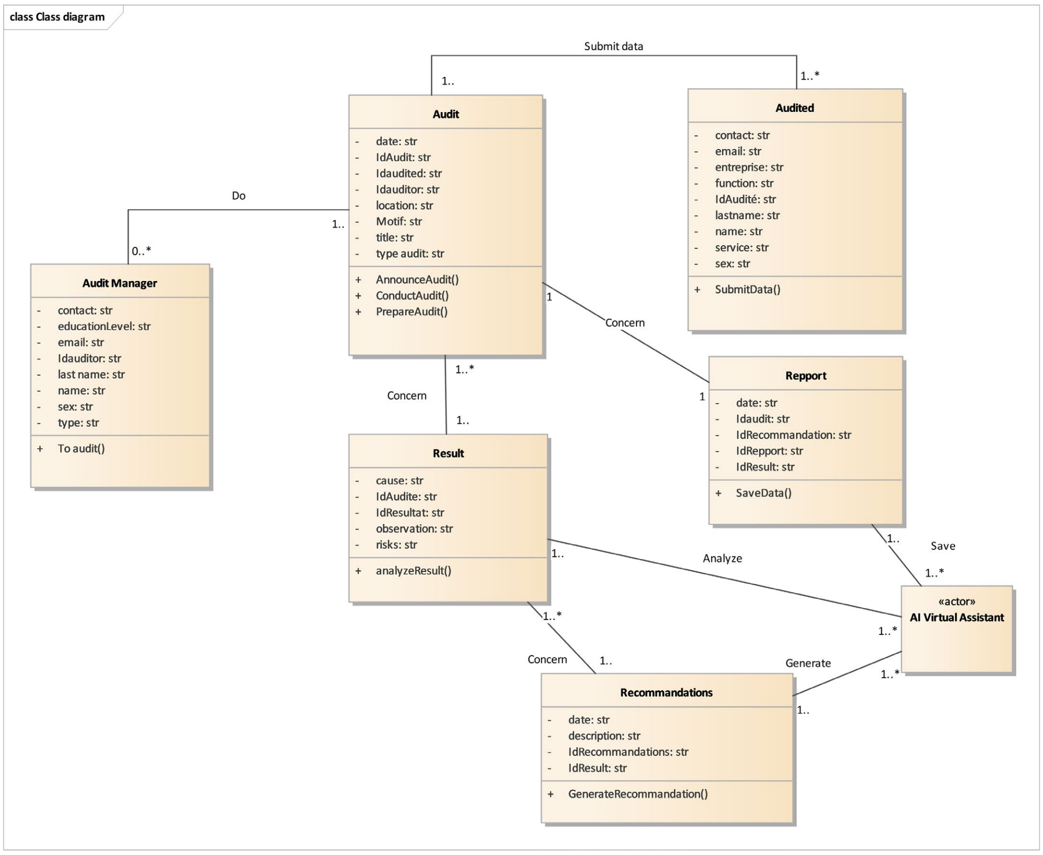

Figure 3. Class diagram.

F) Deployment diagram

The UML deployment diagram is used to represent the physical architecture of the system, i.e. how software components are distributed across the different nodes of the system, and how these nodes interact with each other. This diagram describes the hardware aspects of the system, such as servers, databases, networks, and the devices used to run the software components. Deployment diagrams are used to represent nodes and their connections [14].

As part of your intelligent audit recommendation system, the deployment diagram can show how different software and hardware elements are interconnected to enable the management of audits, results, recommendations, and reports.

As shown in Figure 4, this deployment diagram highlights the physical configuration of our system and how the different elements communicate to ensure reliable and secure operations.

G) Transitions state diagram

The transitions state diagram illustrates the different states of an object or process in the system and the possible transitions between these states depending on the events. It is used to model the dynamic behavior of an entity.

As part of our intelligent audit recommendation system, this diagram describes the lifecycle of an audit process, highlighting changes in the system's state based on actions taken by stakeholders or internal events.

As shown in Figure 5, the transitions state diagram outlines the flow of states and transitions that occur throughout an audit's lifecycle.

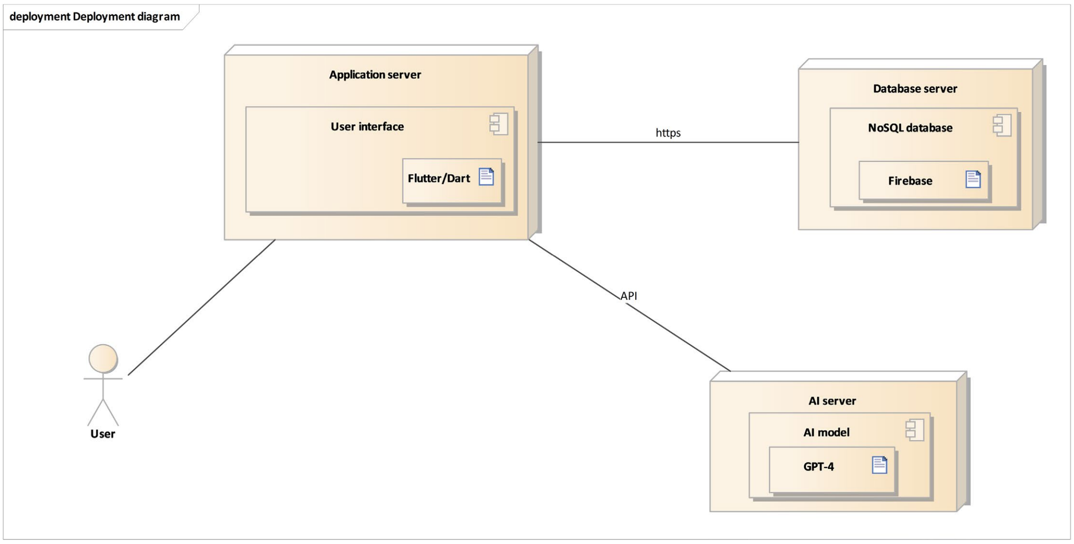

Figure 4. Deployment diagram.

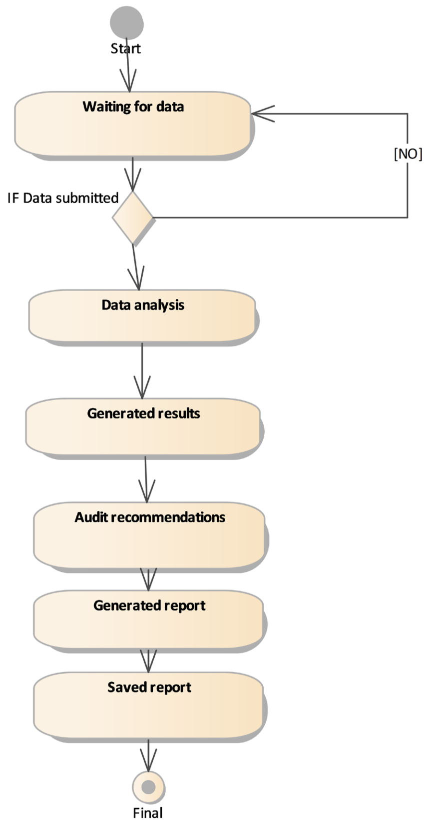

Figure 5. Transitions state diagram.

2.2.3. System Architecture

Our intelligent audit recommendation system is based on a client-server architecture since it will have AI ask questions and the user answer them. And in terms of levels, our architecture is in three layers, a structure widely recognized for its flexibility and modularity. The three main layers are:

a) Frontend layer

The presentation layer is the system's graphical interface. It is responsible for the communication between the user and the underlying functionalities. Designed to be intuitive and accessible, it allows users to easily navigate, access key information, and interact with system features.

As part of our system, this layer is responsible for communication between the user and the Sculpin via the graphical interface where the texts are entered.

b) Logical layer (Backend)

Generally speaking, the logical layer is the heart of the system. It executes business processes and applies defined rules to deliver relevant results. This layer also handles the interactions between the presentation and the database.

In our system, the logic layer includes:

- **Artificial intelligence (AI) algorithms** : These algorithms analyze audit data, detect anomalies, and suggest appropriate recommendations.
- **A business rules engine**: This engine verifies that the recommendations generated comply with internal policies and regulatory standards.
- **Robust APIs**: These allow the system to be integrated with other tools, such as ERP or financial management software.

For example, in our system, the logical layer analyzes the data through natural language processing (NLP) models, to identify, for example, an inconsistency in reported expenses and recommend a thorough check for that budget line.

c) Data layer (Database)

The data layer is responsible for storing and managing the information necessary for the proper functioning of the system. It also ensures the security and integrity of sensitive data.

In our system, this layer:

- **Stores audit reports and recommendations**: Each recommendation is associated with a status (pending, in progress, completed).
- **Manages activity history**: Here, the layer takes care of backing up the recommendation histories in the system.

As illustrated in Figure 6, the architecture diagram of our intelligent audit recommendation system shows how the frontend, logic, and data layers are structured and interact.

3. Results and Discussions

The implementation of the solution designed to optimize the management of audit recommendations in Congolese state-owned enterprises is based on a fully web-based application, accessible via a browser, and deployed on a secure and high-performance infrastructure. This solution incorporates several interfaces and features, carefully developed to simplify the audit process while enhancing the management of recommendations. The application follows an intuitive logic, where each interface is tailored to meet the specific needs of users, whether they are auditors, managers, or public enterprise administrators.

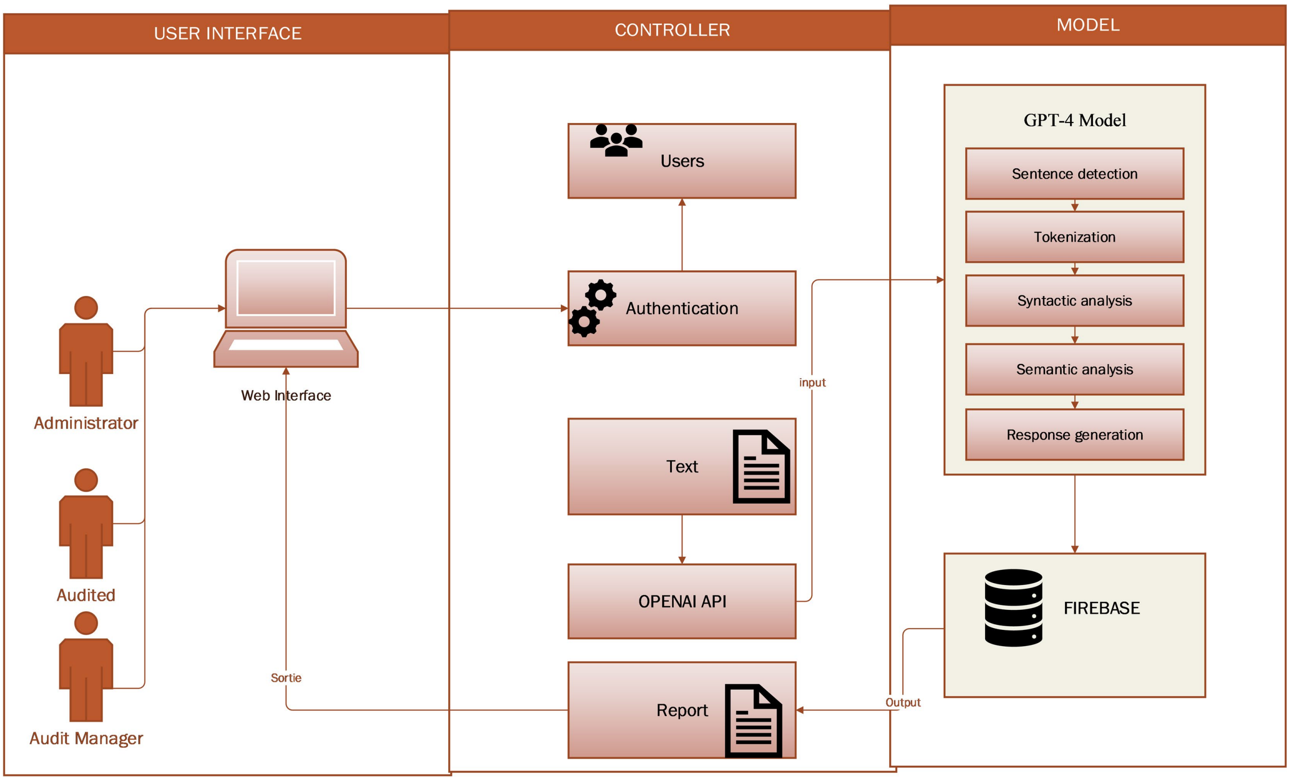

Figure 6. Architecture of our system.

The results of implementing this solution have yielded significant advancements in both efficiency and the relevance of the generated recommendations. First, the automation of key tasks, such as the analysis of audit reports, has considerably reduced processing times. What previously required several hours of manual work is now completed in under 30 minutes, thanks to the integration of GPT-4. This improvement has not only optimized process efficiency but has also freed up valuable time for auditors to focus more on strategic analysis and informed decision-making.

From a quantitative perspective, the recommendations generated by the system have proven to be highly relevant and actionable. By relying on local data and specific adjustments, the model was able to produce results that were closely aligned with the needs of Congolese public enterprises. An evaluation of the recommendations revealed that nearly 95% of them were directly actionable by stakeholders, thus enhancing the credibility and usefulness of the system. Furthermore, the detailed recording of each recommendation with metadata has improved traceability, increasing transparency and reinforcing confidence in the audit results and their application.

However, the implementation of this solution has not been without challenges. One of the main obstacles encountered was the need to adapt GPT-4 to local contexts, which required an extensive training phase using data specific to Congolese state-owned enterprises. This process involved meticulous data collection, labeling, and integration work to ensure that the recommendations generated were not only relevant but also aligned with local standards and business practices. Additionally, while user adoption has been largely positive, training and awareness efforts were necessary to ensure the effective use of the interface and the features provided.

One of the system's key strengths lies in its ability to offer complete transparency throughout the process. Every step, from initial analysis to the implementation of recommendations, is recorded and easily traceable through the integration of Firebase. This approach has not only reduced errors but also established a clear and accessible tracking system for auditors and managers, thereby enhancing the reliability and clarity of the results produced.

3.1. Evaluation of the Relevance of the Recommendations

To validate the effectiveness of the system, an evaluation phase was conducted with a panel of 8 internal audit experts from 4 state-owned enterprises in the city of Lubumbashi. These experts were presented with 120 recommendations automatically generated by the system based on real cases.

The evaluation criteria were:

- The clarity and comprehensibility of the recommendation (rated on a scale of 1 to 5),
- Its relevance to the identified issue,
- Its operational feasibility,
- And its actual adoption in the final audit reports.

The results revealed that:

✓ 114 recommendations (95%) were deemed directly actionable (average scores ≥ 4/5),

✓ 6 recommendations were manually adjusted,

✓ The average time required to analyze a report was reduced to 28 minutes, compared to the previous average of 3 hours.

These results demonstrate a significant gain in productivity and an improvement in the targeting of proposed corrective measures.

4. Conclusions

The implementation of a smart system for the management of audit recommendations in Congolese state-owned enterprises marks a significant step towards more transparent, efficient and results-oriented governance. By leveraging cutting-edge technologies such as GPT-4 and Firebase, this solution has transformed historically manual and time-consuming processes into an automated, fast, and accurate system.

The results demonstrate the positive impact of automation and artificial intelligence on audit practices. Not only was the time to analyze the reports significantly reduced, but the recommendations produced also proved to be more relevant and actionable. In addition, the integration of traceability mechanisms has increased transparency and stakeholder trust, helping to improve user buy-in and the overall efficiency of the system.

However, this technological advancement comes with challenges. Adapting the GPT-4 model to the local context required a significant effort to train the system on specific data, while user adoption highlighted the need for tailored training to maximize the use of the proposed features. These aspects underline the importance of maintaining an evolutionary approach and supporting users in the transition to these new digital tools.

In conclusion, this project provides a solid basis for modernizing audit processes in public companies. It also paves the way for future innovations, such as the integration of predictive capabilities or the expansion of the system to other lines of business. The future of this solution lies in its ability to evolve and adapt to the growing needs of organizations, while continuing to promote more efficient and transparent management of public resources.

4.1. Limitations of the GPT-4 Model and Bias Management

Although the integration of GPT-4 is powerful, it does have certain limitations. This model can inherit biases present in its training data. To minimize this risk, we implemented the following measures:

✓ Used only expert-validated data,

✓ Integrated a human validation layer involving senior auditors,

✓ Established a double-review process (machine + human) before final validation.

Tests were also conducted to detect systemic biases (for example, favoring certain types of actions or overlooking recurring but sensitive issues). In cases where such biases were identified, prompt adjustments were made to restore balance.

Furthermore, to maintain impartiality in an environment prone to corruption, all generated recommendations are recorded via a blockchain infrastructure, preventing any post-generation modifications.

4.2. Limitations in Handling Legal and Financial Complexity

GPT-4 also shows limitations in interpreting certain documents with high legal or accounting density. For instance, reading specific clauses derived from OHADA law or ministerial decrees requires an advanced level of legal contextualization, which the model does not fully master.

To address this, we integrated an additional "rule engine" module that acts as a filter for the recommendations generated by GPT, comparing them against current regulatory standards. In the future, we plan to collaborate with legal experts to annotate a specialized dataset that will allow for more precise model adjustments.

4.3. Future Improvement Pathways

The contributions of the designed intelligent system are significant, but further efforts are necessary to enhance its robustness when dealing with complex financial or legal analysis cases. One of the envisioned perspectives is the creation of a Congolese annotated legal-financial corpus to enrich the model's understanding capabilities. In addition, a partnership with institutions specialized in auditor training could facilitate the large-scale adoption of the system.

The continuous evolution of the model, accompanied by ethical validation mechanisms and bias control, will ultimately provide a reliable, transparent tool that is fully adapted to the institutional environment of the Democratic Republic of Congo.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Racha, C. (2024) The Contribution of Digital Technology in Auditing. PhD Thesis, Ecole Supérieure de Gestion et d'Economie Numérique. http://dspace.esgen.edu.dz:8080/xmlui/handle/123456789/633

[2] Anis, A. (2022) The Challenges of the Use of Big Data Analytics on the Effectiveness and Efficiency of Internal Audit. Master's Thesis, University of Mouloud Mammeri of Tizi Ouzou. https://www.ummto.dz/dspace/bitstream/handle/ummto/19156/memoire.pdf?sequence=1

[3] Ramzi, K. (2024) The Influence of Artificial Intelligence on the Audit Mission in Algeria. Master's Thesis, École Supérieure de Commerce. http://dspace.esc-alger.dz:8080/xmlui/handle/123456789/2062

[4] Ali, D. and Mansour, B. (2023) Integrating AI into Auditing: The Effect on the Audit Process. https://www.researchgate.net/profile/Djellaba-Ali/publication/376112271_Integration_de_l'IA_dans_l'audit_l'effet_sur_le_processus_d'audit/links/656a063ace88b8703127f27b/Integration-de-lIA-dans-laudit-leffet-sur-le-processus-daudit.pdf

[5] Baktash, J.A. and Dawodi, M. (2023) GPT-4: A Review on Advancements and Opportunities in Natural Language Processing. arXiv:2305.03195

[6] Roumeliotis, K.I. and Tselikas, N.D. (2023) ChatGPT and Open-Ai Models: A Preliminary Review. *Future Internet*, **15**, Article 192. https://doi.org/10.3390/fi15060192

[7] Quinto, J.-M. (2025) Development of a Medical Prescription Evaluation Application with Flutter. https://sonar.ch/hesso/documents/314995

[8] Narimane, B. and Nassima, A.I. (2025) Design and Implementation of a NoSQL database under HBASE and Firebase Case of an earthquake. PhD Thesis, Mouloud Mammeri University. https://www.ummto.dz/dspace/bitstream/handle/ummto/12961/Bennabi-Narimane.pdf

[9] Roques, P. and Vallée, F. (2000) UML in Action: From Needs Analysis to Design in

Java. Eyrolles.

[10] Roques, P. (2024) With SysML. http://multimedia.fnac.com/multimedia/editorial/pdf/9782212136418.pdf

[11] Pascal, R. (2011) UML 2.5 by Practice: Case Studies and Corrected Exercises. Eyrolles Publishing.

[12] Paludetto, M., Delatour, J. and Benzina, A. (2004) UML et réseaux de Petri. *Techniques et sciences informatiques*, **23**, 543-567. https://doi.org/10.3166/tsi.23.543-567

[13] Lamy, J.-P. (2012) SysML, a Model Language. *Journal Of Technology*, **179**, 32-48.

[14] Quatrani, T. (2024) UML Modeling with Rational Rose 2000. Eyrolles. https://coursinfopdf.com/remo-pdf/cours-info.370.pdf