MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

ECOLE SUPERIEURE DE COMMERCE (ESC ALGER)

MOULOUD KACEM NAIT BELKACEM

Dissertation submitted in partial fulfilment of the requirements for the master's degree in financial sciences and accounting.

Specialty: Accounting and Finance

Theme:

THE IMPACT OF ARTIFICIAL INTELLIGENCE ON EXTERNAL AUDITING PRACTICES: CASE STUDY OF MAJOR ALGERIAN COMPANIES

Prepared by:

BELKHIR Aya

Supervised by:

Dr. BEHILIL Zeneb

Location of the internship: NCRT-National Company of rail transport-

Duration of the internship: from 15-04-2026 to 12-05-2026

Academic Year 2025/ 2026

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DEDICATION

To my Mother

the first universe I ever knew,
whose hands were my earliest home,
whose voice still lives in the marrow of my courage.
Everything I am began inside you.

To Maisseun

my sister. my first friend.my truest mirror.
You have seen me at my most broken
and at my most radiant
and you loved me the same through all of it.
There is something sacred about someone
who grew up inside the same walls as you,
breathed the same air, carried the same weight
and still chose, every single day, to stay close.
You never asked me to explain my storms.
You just stood in them with me.
In your laughter I hear home.
In your eyes I see the version of myself i am still fighting to become.
Thank you for never letting me forget her.

To Asmaa

my sister, my quiet anchor,
steady as stone beneath moving water.
You never needed grand words to love me
your presence was always the loudest poem.

To Sofiane & Hamza

my brothers, my stubborn stars,
who taught me that strength wears many faces.
Even in silence, you have been a shield
I did not always know I was standing behind.

To Aisha

if there is one name this book owes its existence to,
it is yours.
You were never just a friend.
You were the kind of person who shows up
not only when the world is celebrating you,
but when it is consuming you
and you brought nothing but your whole, honest self.
You held me when I had forgotten
what it felt like to be held.
You laughed with me before the storm
and sat with me in the silence after.

There is a specific kind of rare
that does not have a word in any language
the kind that makes you believe in people again
simply by existing.
You are that kind.
And I will spend the rest of my life
being grateful you chose me too.

To Abir
my dearest companion on the crooked roads,
who walked beside me when walking was difficult
and asked nothing in return but the truth.
You are proof that real love shows up.

To Imane
who lives in a tender, sacred chapter of my story,
whose name I carry like a pressed flower
between the pages of who I used to be.
Thank you for the warmth, however brief.

To Rayane, Rania & Ikram
my second home. my borrowed big sisters.
The ones whose presence always felt like
walking through a door and finally exhaling.
You did not raise me,
and yet something in me grew taller around you.
You showed me what it looks like to be a woman who takes
up space, who is soft and strong in the same breath.
In your home I was never a guest
I was simply, quietly, one of yours.

To Mr. L
the one who knew me at my most unrecognizable
and stayed anyway.
There are people who pass through your life
and people who quietly become part of its structure
the kind you stop noticing only because
they have already become the walls.
You know what you are to this story.
Even if no one else does.

And to the one I will not name here
the absence that came before I was old enough
to know what absence meant.
You were a silence shaped like a person.
A space at the table I learned not to look at.
And yet even the things we lose without holding
leave their shape in us forever.
You made me an ash before I knew fire.
And I forgive you not for you, but for me.

From all of this the love and the loss,
the warmth and the silence,
the fire that consumed and the fire that forged

. . ✦ . .

She was born.
Not from what survived the burning
but from what the burning finally set free.

✦

From all of this the love and the loss,
the warmth and the silence
the fire that consumed and the fire that forge

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List of Abbreviations

Abbreviation	Full Meaning
AI	Artificial Intelligence
ADA	Audit Data Analytics
RPA	Robotic Process Automation
NLP	Natural Language Processing
ML	Machine Learning
AGI	Artificial General Intelligence
CNN	Convolutional Neural Network
RNN	Recurrent Neural Network
DA	Data Analytics
IT	Information Technology
ISA	International Standards on Auditing
IAASB	International Auditing and Assurance Standards Board
IFAC	International Federation of Accountants
IESBA	International Ethics Standards Board for Accountants
GAAS	Generally Accepted Auditing Standards
AICPA	American Institute of Certified Public Accountants
ISO	International Organization for Standardization
IIA	Institute of Internal Auditors
IPPF	International Professional Practices Framework
ISPPIA	International Standards for the Professional Practice of Internal Auditing
ISACA	Information Systems Audit and Control Association
ITAF	Information Technology Audit Framework
CNC	Conseil National de la Comptabilité
NAA	Algerian Auditing Standards
IEEE	Institute of Electrical and Electronics Engineers
OFPPT	Office de la Formation Professionnelle et de la Promotion du Travail
GDPR	General Data Protection Regulation
PCA	Principal Component Analysis
VIF	Variance Inflation Factor
ISAC	Information Systems Audit and Control
CAG	Computer-Assisted Governance

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Abstract

This study examines the impact of Artificial Intelligence technologies on the effectiveness of external auditing practices in major Algerian companies. The research focuses on the main AI technologies used in auditing, namely Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP). To achieve the objectives of the study, a theoretical review and an empirical study based on a questionnaire distributed to external auditors and professionals were conducted.

The findings reveal that Artificial Intelligence positively contributes to improving the efficiency and effectiveness of external audit practices. AI technologies enhance anomaly detection, support risk assessment, improve the reliability of audit evidence, automate repetitive tasks, and facilitate auditors' decision-making processes. However, the study also highlights challenges related to technological adaptation, professional training, and data security.

This research contributes to the growing literature on the application of Artificial Intelligence in auditing within the Algerian context and provides recommendations for the effective integration of AI technologies into external audit practices.

Keywords : Artificial Intelligence, External Audit, Audit Data Analytics, Robotic Process Automation, Natural Language Processing, Algeria.

الملخص

تهدف هذه الدراسة إلى تحليل أثر تقنيات الذكاء الاصطناعي على فعالية ممارسات التدقيق الخارجي في المؤسسات الجزائرية الكبرى. وتركز الدراسة بشكل أساسي على تقنيات الذكاء الاصطناعي المطبقة في مجال التدقيق، والمتمثلة في تحليل بيانات التدقيق(Audit Data Analytics - ADA) ، والأتمتة الروبوتية للعمليات(Robotic Process Automation - RPA) ، ومعالجة اللغة الطبيعية (Natural Language Processing - NLP).ولتحقيق أهداف الدراسة، تم الاعتماد على مراجعة نظرية بالإضافة إلى دراسة ميدانية استندت إلى استبيان وُجّه إلى المدققين الخارجيين والمهنيين في المجال.

أظهرت نتائج الدراسة أن الذكاء الاصطناعي يساهم بشكل إيجابي في تحسين فعالية وأداء ممارسات التدقيق الخارجي. كما بينت النتائج أن تقنيات الذكاء الاصطناعي تساعد في تحسين اكتشاف الأخطاء والانحرافات، ودعم تقييم المخاطر، وتعزيز موثوقية أدلة التدقيق، وأتمتة المهام المتكررة، إضافة إلى تسهيل عملية اتخاذ القرار لدى المدققين. ومع ذلك، أبرزت الدراسة وجود بعض التحديات المرتبطة بالتكيف التكنولوجي، والتكوين المهني، وأمن البيانات.

تساهم هذه الدراسة في إثراء الأدبيات المتعلقة بتطبيقات الذكاء الاصطناعي في مجال التدقيق ضمن السياق الجزائري، كما تقدم مجموعة من التوصيات من أجل الإدماج الفعّال لتقنيات الذكاء الاصطناعي في ممارسات التدقيق الخارجي.

الكلمات المفتاحية :الذكاء الاصطناعي، التدقيق الخارجي، تحليل بيانات التدقيق، الأتمتة الروبوتية للعمليات، معالجة اللغة الطبيعية، الجزائر.

GENERAL INTRODUCTION

Artificial Intelligence has become one of the most significant technological innovations shaping modern economies and business environments. Rapid developments in computational power, machine learning, and data science have transformed the way organizations process information, make decisions, and manage operations. AI technologies are now capable of analysing massive volumes of data, identifying hidden patterns, and automating complex tasks with high levels of speed and accuracy. As a result, Artificial Intelligence is increasingly considered a strategic tool for improving efficiency, productivity, and decision-making quality across various sectors.

Among the sectors most affected by this technological transformation is the field of external auditing. Traditionally, external auditing has relied on manual procedures, sampling techniques, and documentary verification to ensure the credibility and reliability of financial information. Although these conventional methods have long contributed to strengthening trust in financial reporting, they are becoming less efficient in modern business environments characterized by digitalized accounting systems, large transaction volumes, and real-time financial reporting. Consequently, auditors are now required to process larger amounts of financial and non-financial information within shorter periods while maintaining high standards of audit quality, professional judgment, and assurance.

In response to these challenges, Artificial Intelligence technologies are increasingly being integrated into external auditing practices. Technologies such as Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP) provide auditors with advanced tools capable of automating repetitive procedures, analysing entire datasets instead of limited samples, improving anomaly detection, strengthening risk assessment, and enhancing the quality of audit evidence. Therefore, the relationship between Artificial Intelligence and external auditing has become a central issue in contemporary auditing research and professional practice.

The integration of AI into auditing not only improves audit efficiency and effectiveness but also transforms traditional auditing approaches into more data-driven and technology-oriented processes. However, this transformation also raises important challenges related to cybersecurity, data governance, algorithmic transparency, and the need for auditors to develop advanced technological and analytical competencies.

Despite the growing international adoption of AI technologies in auditing, their implementation in emerging economies such as Algeria remains relatively limited and at an early stage. Although Algerian audit firms are gradually adopting digital technologies, several

obstacles continue to hinder full AI integration, including limited technological infrastructure, insufficient professional training, and the absence of comprehensive regulatory frameworks. Therefore, analysing the impact of Artificial Intelligence technologies on external auditing practices in the Algerian context has become both academically and professionally important. Consequently, this study seeks to address the following main research problem:

Main Problem

The rapid development of Artificial Intelligence technologies has transformed modern auditing practices by introducing advanced tools capable of improving efficiency, accuracy, and decision-making processes. Technologies such as Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP) are increasingly integrated into external auditing activities to enhance audit performance and reliability.

Accordingly, this study seeks to analyse the impact of Artificial Intelligence technologies on external auditing practices in the Algerian context. More specifically, it examines how these technologies contribute to improving audit efficiency, strengthening anomaly detection and risk assessment, and enhancing the quality and accuracy of audit outputs.

Therefore, the main research question can be formulated as follows:

To what extent does the integration of Artificial Intelligence technologies transform external auditing practices and improve audit efficiency, effectiveness, and quality in the Algerian context?

Sub-Questions

To address the main research problem, the study is based on the following sub-questions:

Sub-Question 01

To what extent does the integration of Audit Data Analytics (ADA) improve anomaly detection and risk assessment in external auditing?

Sub-Question 02

To what extent does the integration of Robotic Process Automation (RPA) enhance the efficiency and productivity of external audit tasks?

Sub-Question 03

To what extent does the integration of Natural Language Processing (NLP) improve the quality and accuracy of external auditing?

Research Hypotheses

Based on the theoretical framework and previous studies related to Artificial Intelligence and external auditing, the following hypotheses were formulated for empirical testing:

Main Hypothesis

The integration of Artificial Intelligence technologies significantly improves the effectiveness, efficiency, and quality of external auditing practices.

Sub-Hypotheses

First Hypothesis

The integration of Audit Data Analytics (ADA) significantly improves anomaly detection and risk assessment in auditing.

Second Hypothesis

The integration of Robotic Process Automation (RPA) significantly enhances the productivity and efficiency of audit tasks.

Third Hypothesis

The integration of Natural Language Processing (NLP) significantly enhances the quality and accuracy of external auditing.

Research Objectives

This research aims to analyse the impact of Artificial Intelligence on external auditing practices in Algerian companies. It seeks to evaluate how AI technologies influence audit efficiency, accuracy, and fraud detection, while also examining the adaptation of auditors in terms of skills, methodologies, and professional roles. In addition, the study aims to identify the main opportunities and challenges associated with the integration of Artificial Intelligence into audit processes within the Algerian context.

Importance of the Study

The importance of this research is justified by several considerations. First, Artificial Intelligence represents a major technological transformation that is reshaping professional practices, including auditing. Understanding its impact is essential for anticipating future developments in the profession and ensuring that auditors remain capable of fulfilling their responsibilities in an increasingly digital environment.

Second, external auditing plays a fundamental role in ensuring financial transparency, reliability, and trust in economic systems. Consequently, any technological transformation affecting audit quality has important implications for organizations, investors, and regulators.

Third, within the Algerian context, studies addressing Artificial Intelligence in auditing remain limited despite the growing importance of digital transformation. This creates an academic gap that the present study seeks to address.

Finally, this research provides practical insights for audit professionals and firms regarding the opportunities and challenges associated with adopting Artificial Intelligence technologies.

Research Methodology

This study adopts a mixed method approach combining theoretical and empirical analysis. The theoretical component is based on a comprehensive literature review covering external auditing principles, Artificial Intelligence concepts, and their applications in audit processes. The empirical component relies on a questionnaire distributed to auditors and accounting professionals in Algeria. The collected data are analysed using statistical methods in order to examine the relationship between Artificial Intelligence technologies and audit effectiveness and to test the proposed hypotheses.

Previous Studies

Several previous studies have examined the integration of Artificial Intelligence and digital technologies in accounting and auditing.

Behilil Zeneb (2025) analysed the impact of digital transformation on external auditing and the reliability of financial statements in Algeria. The study concluded that digital technologies improve audit quality, strengthen transparency, and enhance the reliability of financial reporting. (Zeneb, The Impact of Digital Transformation on External Auditing and the Reliability of Financial Statements in Algeria, 2025)

First, BENACHOUR Amira et al. (2025), in their article entitled *"The Impact of Artificial Intelligence on Financial Auditing: The Case of Algeria,"* examined the role of Artificial Intelligence in improving financial auditing practices in Algeria. The study found that AI enhances audit quality, anomaly detection, and risk assessment, while also highlighting challenges related to technological infrastructure and specialized competencies. (Amira, Benachour , Kaddai , & Abdelmalek , 2025)

Next, YOUNES Chanez Sarah (2023), in her master's thesis *"Artificial Intelligence and the Transformation of Accounting and Auditing Professions,"* demonstrated that Artificial Intelligence contributes to automating repetitive tasks, improving financial data processing, and increasing audit efficiency. The study also emphasized the need for auditors to develop new digital competencies. (Sarah, 2023)

Subsequently, BOULKOUR Amani and LALMI Rayane (2024), in their thesis *"The Impact of the Use of Digital Tools on the Quality of Accounting and Financial Audit: The Case of EY Algeria,"* concluded that digital technologies improve the speed of audit procedures,

facilitate data analysis, and strengthen the reliability of audit evidence. (Amani & Lalmi Rayane, 2024)

Furthermore, AMARI Badiaa (2021), in her article *"Artificial Intelligence, Accounting Information and the Processing of Accounting Documents: What Feasibility for Algerian Companies?"* examined the feasibility of integrating Artificial Intelligence into accounting information systems. The findings indicated that AI technologies improve accounting data processing and enhance the quality of financial information despite technological and financial constraints. (Badiaa, 2021)

Finally, BENHAOUES Karima and BELAID Karim (2025), in their article *"The Reality of Using Artificial Intelligence in the Accounting Field in Algeria,"* evaluated the adoption of Artificial Intelligence technologies in accounting and auditing practices in Algeria. The study revealed a gradual integration of AI technologies in audit firms, particularly for data analysis and task automation, while emphasizing challenges related to training and resistance to change. (Karima & Belaid , 2025)

Existing literature has mainly focused on digitalization and the general integration of Artificial Intelligence in accounting and auditing. However, few studies have specifically analysed the impact of technologies such as Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP) on the effectiveness of external auditing within the Algerian context. Therefore, this research seeks to address this gap by examining the influence of these technologies on external audit practices in Algeria and identifying the opportunities and challenges associated with their adoption.

Work Plan

This thesis is structured into three main chapters:

The first chapter

Presents the theoretical framework of external auditing, including its objectives, principles, and methodologies.

The second chapter

Focuses on Artificial Intelligence and its applications in auditing, highlighting its tools, advantages, and limitations.

The third chapter

Presents the empirical study, including data analysis, interpretation of results, and discussion of findings in order to test the hypotheses and answer the research problem.

Chapter 01:

Theoretical Foundations of External Audit

Introduction

One of the most important roles of auditing in the current organizational world is the enhancement of transparency and accountability, which is achieved through proper resource management. Auditing makes the organization more transparent, increases the reliability of accounting information, and improves the level of confidence in the financial information of the company on behalf of various stakeholders such as shareholders, lenders, and regulatory bodies.

Auditing can also be seen as a means for ensuring that organizations conform to applicable laws and regulations in the highly competitive economic environment. This process goes further beyond verifying accounts and involves assessing the internal control system, operational performance, compliance with the law, and risk management activities within the organization. Thus, a variety of audits have developed, with distinct characteristics related to the goals, scope, methodology, and performing entities of the audit process.

This introductory part of the chapter sets the basic context for understanding the nature of auditing by discussing its history, different definitions, and standards. The evolution from the initial goal of verifying accounts to codifying international and national standards for conducting audits can be traced through the course of this section.

Secondly, the discussion on auditing principles and standards is provided in the second part. The emphasis on ethics will be discussed, and the standards will also be introduced, including integrity, objectivity, confidentiality, and professional competence as well as international, regional, and Algerian standards that provide an effective methodological approach towards audits. Standards play an important role in ensuring that the process of auditing is consistent, reliable, and comparable in terms of various organizations and industries, thus making auditing more credible.

Finally, in the third part, there is the description of the types of audits based on the purposes of audits and their performers. Financial audits, operational audits, compliance audits, forensic audits, and information system audits are considered to present the variety of auditing in contemporary organizations. Thus, auditing can be seen as a flexible area that adapts to various organizational needs and requirements.

Overall, the chapter provides not only the definition of external auditing but also its theoretical foundations and standards along with different audit practices. The chapter prepares the reader for further reading, especially the chapter dedicated to innovative changes in audit practices.

Section 01: General Concepts of Audit

This section lays the groundwork for understanding auditing by presenting its core concepts and essential principles. It aims to clarify the fundamental role of audit in evaluating financial information and ensuring its reliability and compliance with established standards.

1. History and Definition of Auditing

This part briefly outlines the evolution of auditing and provides a clear definition of the concept, helping to understand how the profession has developed and how it is currently defined within the context of financial reporting and assurance.

1.1. History of Auditing

The term "audit" is derived from the Latin word meaning **"**a hearing**."** Auditing originated over 2,000 years ago, first in Egypt and later in Greece, Rome, and other regions, where citizens or sometimes slaves who were entrusted with the collection and disbursement of public funds were required to give an oral account of their management of those funds in public, to a responsible official (an auditor**)**. (Porter, Jon, & David, 2014, p. 23)

The practice of auditing has a long history, dating back to ancient civilizations. Early forms of auditing were used primarily to verify the records of government officials and treasurers, ensuring that public funds were properly accounted for. In the medieval period, auditors were employed by monarchies and religious institutions to oversee financial activities and safeguard assets. Modern auditing, as we know it today, began to take shape during the Industrial Revolution, when the growth of large-scale businesses and corporate structures made it necessary to establish more formalized auditing processes. By the early 20th century, the need for greater corporate transparency led to the development of auditing standards and regulatory frameworks. Auditing has become an integral part of corporate governance, with many professional bodies, such as the Institute of Internal Auditors (IIA) and the Information Systems Audit and Control Association (ISACA), playing a pivotal role in shaping the profession. (Krothapalli, 2025, p. 31)

1.2. Definition of Auditing

Several professional organizations and academic institutions have proposed definitions of auditing, each emphasizing particular aspects of the audit process. These definitions generally highlight the systematic examination of financial information, the collection and evaluation of evidence, and the expression of an independent opinion regarding the reliability of financial statements.

- **Krothapalli (2025) defines auditing as** "Auditing is the systematic examination of financial records, information systems, business, technical processes, and other relevant documentation. This is done to assess their accuracy, completeness, and adherence to established standards or regulations. It serves as a critical mechanism for ensuring transparency, accountability, and the efficient management of resources. Auditing is often performed by internal or external auditors who are tasked with verifying that financial reports or organizational processes, either business or technical, comply with applicable laws, regulations, and standards." (Krothapalli, 2025, p. 31)
- **Anderson (1977) captured the essence of auditing when he stated** "The practice of auditing commenced on the day that one individual assumed stewardship over another's property. In reporting on his stewardship, the accuracy and reliability of that information would have been subjected to some sort of critical review" (B.Anderson, 1977, p. 6)
- **A comprehensive definition of auditing is as follows** "Auditing is a systematic process of objectively gathering and evaluating evidence relating to assertions about economic actions and events in which the individual or organisation making the assertions has been engaged, to ascertain the degree of correspondence between those assertions and established criteria, and communicating the results to users of the reports in which the assertions are made." (Committee on Basic Auditing Concepts, 1973, p. 8)
- **IFAC Definition** "According to the International Federation of Accountants (IFAC), the objective of an audit is to enhance the level of confidence that the intended users can place in the financial statements. To achieve this objective, the auditor expresses an opinion on whether the financial statements have been prepared, in all material respects, in accordance with the applicable financial reporting framework." (Office de la Formation Professionnelle et de la promotion du Travail (OFPPT), 2023, pp. 7-9) Translated by The Researcher
- **Definition by the American Accounting Association** "An audit is the process of objectively and systematically gathering and evaluating evidence related to assertions about economic facts and events. The purpose of this process is to ensure that these assertions correspond to accepted criteria, so that the results of the audit can be communicated reliably to the intended users." (Office de la Formation Professionnelle et de la promotion du Travail (OFPPT), 2023, pp. 7-9) Translated by the Researcher

Based on several definitions from the literature, auditing can be understood as a structured, systematic, and objective process that involves the collection and evaluation of evidence related to financial information, organizational operations, or information systems. Its purpose is to assess the reliability, accuracy, and compliance of these elements with established standards or

criteria, in order to express an informed opinion and enhance stakeholder's confidence, while ensuring transparency and accountability in the management of resources.

2. Principles and Standards of auditing

Auditing is based on fundamental principles and professional standards that guide the auditor's work and ensure its quality and consistency. These frameworks define how audits are planned, conducted, and reported, while promoting transparency, reliability, and stakeholder's confidence in financial information.

2.1. Principles of auditing

Auditing principles form the foundation of a high quality and reliable audit process. They guide auditors in planning, performing, and reporting audits with consistency, integrity, and professionalism. These principles represent the key concepts that ensure the effectiveness and credibility of the audit process. (Krothapalli, 2025, pp. 48-49) They are as follows:

2.1.1. Integrity: The cornerstone of auditing is integrity. Auditors are required to be truthful and honest in their work. They must be honest in all of their interactions and make sure that no information is misrepresented, concealed, or misled. In order to maintain integrity, auditors must also refrain from letting their personal relationships or interests cloud their professional judgment.

2.1.2. Objectivity: The requirement for auditors to remain neutral and impartial in their work is known as objectivity. Biases, conflicts of interest, and excessive influence from management or other stakeholders must be avoided. In order to ensure that the auditors conclusions and findings are based only on the evidence collected and are unaffected by outside pressures, objectivity is crucial.

2.1.3. Confidentiality: Sensitive and private information about the company they are auditing is frequently accessible to auditors. Unless disclosure is required by law or necessary to prevent unlawful activity. the principle of confidentiality guarantees that auditors do not misuse or reveal this information without the appropriate authorization. Maintaining confidentiality fosters trust between the auditor and the company and helps safeguard the client's privacy.

2.1.4. Professional competence and due care: In order to stay current with changes in accounting standards, auditing methods, and regulatory requirements, auditors are expected to maintain a high level of professional competence. The diligence with which auditors must complete their work to ensure that they fulfil the necessary standards of the profession is

referred to as "due care." If auditors don't have the skills or resources to do an audit well, they shouldn't do.

2.1.5. Professional behaviour: In addition to adhering to all applicable laws, rules, and professional standards, auditors must refrain from any behaviour that might bring the auditing profession into disrepute. Avoiding behaviours that could give the impression of improper behaviour, or a lack of professionalism is part of this.

2.1.6. Codes of conduct and ethical guidelines: Auditors are required to abide by codes of conduct and ethical guidelines established by various professional bodies. These rules help auditors navigate difficult ethical dilemmas that may come up during the audit process and set clear expectations for behaviour.

2.1.7. Evidence-Based Approach: Audit conclusions should be based on sufficient and appropriate verifiable evidence. This ensures that findings are reliable, objective, and supported by evidence rather than assumptions. (Ramaswamy, 2026, pp. 40-41)

2.1.8. Management of the Audit Program: Audit programs should be properly designed and managed through clear guidelines that enable organizations to plan and conduct audits effectively. This ensures that audits are carried out in a consistent, objective, and systematic manner. (Ramaswamy, 2026, pp. 40-41)

2.1.9. Competence and Evaluation of Auditors: Auditors must possess the necessary skills, knowledge, and professional competence to perform their duties effectively. Continuous evaluation and training are essential to maintain high auditing standards. (Ramaswamy, 2026, pp. 40-41)

2.2. Auditing Standards

Auditing standards provide a framework for auditors to perform their work in a systematic, consistent, and reliable manner. These standards ensure that audits are conducted with a high degree of professionalism and that the findings are comparable and trustworthy across organizations and industries. Different bodies have developed standards depending on the type of audit being performed. In the following sub sections, we will explore key global and regional auditing standards. (Krothapalli, 2025, pp. 39-42)

2.2.1. International Standards on Auditing

The International Standards on Auditing (ISAs) are a set of principles issued by the International Auditing and Assurance Standards Board (IAASB). ISAs provide a globally recognized framework for auditing financial statements and are widely used across many countries. The primary objectives of ISAs are as follows:

- Ensuring high quality audits;
- Promoting consistency in the auditing process;
- Providing clear guidance on how audits should be performed.

Key principles of ISAs are listed here:

- **Planning the audit:** Auditors are required to develop a plan that defines the scope and objectives of the audit;
- **Risk assessment:** ISAs emphasize the identification of significant risks that could lead to material misstatements;
- **Gathering evidence:** Auditors must obtain sufficient and appropriate audit evidence to support their conclusions;
- **Reporting:** The auditor's report should provide a clear and objective assessment of the financial statements fairness.

Countries that have adopted ISAs often customize the standards to align with their local regulations or accounting principles.

2.2.2. Generally Accepted Auditing Standards

In the United States, Generally Accepted Auditing Standards (GAAS) are established by the American Institute of Certified Public Accountants (AICPA). GAAS are designed to provide a comprehensive set of guidelines for conducting audits of both private and public entities. GAAS shares many similarities with ISAs, but they also reflect the unique legal and regulatory environment of the U.S.

The GAAS framework is built around three categories:

- **General standards:** Address the qualifications and ethical standards required of auditors (e.g., competence, independence, and due professional care);
- **Standards of fieldwork:** Guide how audits should be conducted, including planning, internal control assessment, and evidence collection;
- **Standards of reporting:** Define how audit results should be communicated, emphasizing fairness and the disclosure of any identified issues.

GAAS is applied primarily in the U.S., though elements of it are integrated into other international auditing standards.

2.2.3. ISO19011:2018

ISO 19011:2018 is a globally recognized standard that provides guidelines for auditing management systems, including quality management, environmental management, and other areas such as occupational health and safety or energy management. Unlike ISAs and GAAS, which focus on financial audits, ISO 19011 offers a comprehensive approach to auditing various management systems within organizations.

Key features of ISO 19011 are as follows:

- **Applicability:** The standard applies to audits of different types of management systems, making it highly versatile;
- **Principles of auditing:** ISO 19011 outlines the principles of auditing, such as integrity, fair presentation, due professional care, confidentiality, and independence;
- **Audit program management:** It emphasizes the importance of establishing an effective audit program that aligns with an organization's goals and risks;
- **Competence of auditors:** The standard provides guidance on the necessary competencies for auditors, particularly in areas relevant to the systems being audited.

ISO 19011 is widely used by organizations that operate internationally or those with complex operational processes that span multiple domains (e.g., technology, information security, quality, and environment). The standard ensures that audits in these areas are conducted with consistency and thoroughness.

2.2.4. IIA Standards

The IIA sets the professional standards for internal auditors through its International Professional Practices Framework (IPPF), which includes the International Standards for the Professional Practice of Internal Auditing (ISPPIA). These standards are essential for guiding internal auditors on how to perform their duties effectively and maintain objectivity and professionalism.

Core elements of the IIA standards include:

- **Attribute standards:** These standards address the characteristics of the internal audit function, such as independence, objectivity, and the professional competence of internal auditors;

- **Performance standards:** These standards focus on the performance of individual audit engagements, covering areas such as risk assessment, engagement planning, and audit reporting;
- **Implementation standards:** The IIA also provides implementation standards that offer practical guidance on how to apply the attribute and performance standards in different contexts (e.g., public sector, consulting, or assurance engagements). The IIA standards are critical for ensuring that internal audits add value to the organization by improving its risk management, control, and governance processes. The internal audit profession, guided by these standards, plays a vital role in safeguarding organizational integrity.

2.2.5. ISAC ITAF

ISACA is a global association that provides information technology (IT) professionals with knowledge, credentials, training, and community in audit, security, governance, risk, and privacy. ISACA provides a framework titled Information Technology Audit Framework (ITAF) that consists of multiple levels of guidance. The ITAF defines standards and best practices aligned with the sequence of the auditing process in assessing the operational effectiveness of an enterprise and ensuring compliance.

2.2.6. Algerian Auditing Standards (NAA)

The National Accounting Council (Conseil National de la Comptabilité – CNC) draws inspiration from the International Standards on Auditing (ISA) established by the International Auditing and Assurance Standards Board (IAASB) of the International Federation of Accountants (IFAC). This approach distinguishes between behavioural standards and work standards, adopting the same codification as the ISA while introducing certain adjustments to reflect the specific characteristics of the Algerian context. (Conseil National de la Comptabilité, 2016)

Accordingly, the Ministry of Finance issued three decisions, each covering four auditing standards adapted to the particular needs of the auditing profession in Algeria. These standards are as follows:

The first set is defined under Decision No. 002 of February 4, 2016, which includes:

- NAA 210: Agreement on the Terms of Audit Engagements;
- NAA 505: External Confirmations;
- NAA 560: Subsequent Events;
- NAA 580: Written Representations.

The second set is established under Decision No. 150 of October 11, 2016, comprising:

- NAA 300: Planning an Audit of Financial Statements;

- NAA 500: Audit Evidence;
- NAA 510: Initial Audit Engagements Opening Balances;
- NAA 700: Forming an Opinion and Reporting on Financial Statements.

The third set is introduced under Decision No. 23 of March 15, 2017, including:

- NAA 520: Analytical Procedures;
- NAA 570: Going Concern;
- NAA 610: Using the Work of Internal Auditors;
- NAA 620: Using the Work of an Auditor's Expert.

Together, these standards provide a structured and harmonized framework for audit practice in Algeria, ensuring consistency with international requirements while addressing national specificities.

3. Types of Audits

Auditing is not a one size fits all approach. Audits can be categorized into several distinct types, each serving a specific purpose. However, the way these types are defined or grouped may differ across various sources, depending on the criteria or context used for classification.

Several different types of audits exist based on various factors such as objectives and scope of the audit, organizational structure, degree of independence, and audit location. In the following subsections, we will explore in detail the main types of audits commonly conducted in organizations. (Krothapalli, 2025, pp. 34-37)

3.1. Types of Audits According to Their Objective

Audits can be classified by their objective, as each type serves a specific purpose, such as assessing financial reliability, ensuring compliance, or evaluating operational performance.

3.1.1. Financial Audit

Financial auditing is among the most widely practiced forms of auditing. Its primary objective is to verify the accuracy and reliability of an organization's financial statements. Through this process, auditors assess whether financial information has been prepared in accordance with applicable accounting standards and regulatory requirements. In addition, financial audits evaluate the reliability of accounting records, the legitimacy of financial transactions, and the safeguarding of company assets. Such audits may be conducted either as statutory engagements required by law or as contractual assignments requested by organizations seeking independent verification of their financial information.

3.1.2. Operational Audit

Operational auditing focuses on examining the efficiency and effectiveness of an organization's operational activities. Rather than concentrating solely on financial data, this type of audit evaluates how resources are utilized and whether organizational processes contribute effectively to the achievement of strategic objectives. By analyzing operational procedures, auditors can identify inefficiencies and propose improvements that enhance productivity and organizational performance.

3.1.3. Information System Audit

Information system auditing examines an organizations IT infrastructure and business applications to ensure that information assets are adequately protected and managed. The audit evaluates whether controls related to confidentiality, integrity, and availability of data are effectively implemented. Additionally, these audits verify compliance with relevant laws and regulations, assess the organizations IT policies and procedures, and review the effectiveness of technical and managerial control measures. Information system audits play a critical role in minimizing IT related risks and supporting informed decision making.

3.1.4. Compliance Audit

Compliance auditing assesses whether an organization adheres to external laws, regulations, and internal policies. This type of audit is particularly important in regulated industries such as finance, healthcare, and environmental management. Compliance audits may be conducted internally or by external auditors. Their findings help organizations identify gaps in regulatory adherence and implement corrective actions to avoid penalties, legal consequences, or reputational damage. The primary focus is on evaluating legal compliance, enforcing internal policies, and reporting non-compliance areas with recommendations for improvement.

3.1.5. Forensic Audit

Forensic auditing is a specialized investigative process aimed at detecting and analysing financial fraud, embezzlement, or other forms of misconduct. Often conducted to support legal proceedings, forensic audits involve detailed examination of financial records to uncover irregularities. Forensic auditors use advanced techniques to trace illicit activities, assess their impact, and prepare evidence that can withstand legal scrutiny. These audits are critical in assisting organizations or courts in addressing financial crimes and protecting stakeholder's interests.

3.2. Types of Audits According to the Auditor

Audits can be classified according to the type of auditor performing the engagement, reflecting differences in independence, objectives, and scope of work.

3.2.1. Internal Audit

Internal auditing is conducted by employees within the organization or a dedicated internal audit department. Unlike external audits, which have a specific scope defined by regulations or contracts, internal audits examine the organizations internal controls, risk management processes, and governance systems. The main goal is to assess operational efficiency, ensure compliance with internal policies and external regulations, and identify areas for improvement. Internal auditors report their findings directly to management and the board of directors. They may also participate in organizational improvement initiatives while maintaining independence and objectivity.

Key objectives of internal auditing include:

- Evaluating the effectiveness of internal controls;
- Ensuring compliance with applicable laws and regulations;
- Identifying opportunities for cost reduction or process improvement;
- Monitoring the implementation of risk management strategies.

3.2.2. External Audit

External auditing is performed by independent auditing firms that are not part of the organization. Its primary purpose is to provide an objective assessment of financial statements or specific business processes. External audits are typically required by law, regulations, or contractual agreements, and they occur periodically rather than continuously. By offering an independent evaluation, external audits enhance the credibility and reliability of financial reporting for external stakeholders such as investors, creditors, and regulatory authorities.

External audits serve several purposes:

- Providing assurance to stakeholders regarding the accuracy of financial statements;
- Detecting potential fraud or mismanagement;
- Verifying adherence to financial reporting standards.

***Table 1** : The Difference Between Internal & Eternal audit*

Basis	Internal Audit	External Audit
Definition	Internal audit evaluates the organization's internal controls, including accounting systems and corporate governance. It ensures compliance with laws and regulations, accuracy of financial reporting, and operational efficiency by identifying issues and correcting deficiencies before external audit review.	External audit aims to determine whether the financial statements present a fair, complete, and accurate view of the organization's financial position by examining accounting records, bank balances, and financial transactions.
Objective	To review internal processes and activities and provide recommendations for improvement where necessary.	To examine and verify the accuracy and reliability of the financial statements.
Who conducts it	Conducted by internal employees of the company (internal audit department).	Conducted by an independent third party external to the organization.
Scope	Defined by the company's management depending on internal needs and risk assessment.	Defined by legal or regulatory authorities or relevant auditing standards.
Reporting responsibilities	Reports functionally to the board of directors, usually through the audit committee, ensuring independence from management.	Reports to shareholders and stakeholders; in the public sector, accountable to legislative bodies. External auditors are independent from management and do not follow management instructions regarding scope.
Users of audit reports	Primarily used by management to detect weaknesses and improve internal processes before external review.	Used by shareholders, investors, regulators, and the public for decision-making and assurance purposes.

Source : (https://www.wallstreetmojo.com/internal-audit-vs-external-audit/, n.d.)

3.3. Types of Audit According to the Legal Status of the Mission

Audits can also be classified according to the legal status of the mission, depending on whether they are mandated by law or conducted on a voluntary basis. This distinction determines the auditor's responsibilities, scope of work, and level of obligation.

3.3.1. Contractual Audit

A contractual audit is an audit engagement agreed upon between an organization and an independent auditor. The objectives and scope are defined in the contract, allowing for flexibility based on the organization's needs. Common examples include financial analysis, tax audits, social audits, and IT audits. Contractual audits are particularly useful for organizations seeking an independent, tailored evaluation outside of statutory requirements.

3.3.2. Statutory Audit

Statutory auditing is a legally regulated process carried out under the framework of statutory auditing. Its goal is to provide an official opinion on the accuracy, completeness, and reliability of a company's financial statements. Statutory auditors must follow professional standards and comply with regulations established by national and international auditing bodies. These audits ensure transparency, maintain stakeholder confidence, and uphold the integrity of financial reporting.

Section 02: Foundations of External Audit

This section introduces the fundamental principles that underpin external auditing, focusing on its objectives, core principles, and role in ensuring the reliability and credibility of financial information. These foundations are essential for understanding the audit process and its contribution to financial transparency and stakeholder confidence.

1. Definition of External Audit

An external audit is an audit performed for parties external to the auditee, and it is to these parties that the auditor reports the audit findings and conclusions. Such audits are conducted by competent and experienced professionals who are independent of the audited entity and its personnel. They are carried out in accordance with requirements defined by, or on behalf of, the parties for whose benefit the audit is performed. (Porter, Jon, & David, 2014, p. 7)

2. Fundamental Principles of External Audit

External auditing is based on several fundamental principles that govern and structure the audit process. (International Ethics Standards Board for Accountants (IESBA), 2018, pp. 18-23)

2.1. Integrity

A professional auditor shall comply with the principle of integrity, which requires an auditor to be straightforward and honest in all professional and business relationships. Integrity implies fair dealing and truthfulness.

A professional auditor shall not knowingly be associated with reports, returns, communications, or other information where the auditor believes that the information:

- Contains a materially false or misleading statement;
- Contains statements or information provided recklessly;
- Omits or obscures required information where such omission or obscurity would be misleading.

2.2. Objectivity

A professional auditor shall comply with the principle of objectivity, which requires an auditor not to compromise professional or business judgment because of bias, conflict of interest, or undue influence of others. A professional auditor shall not undertake a professional activity if a circumstance or relationship unduly influences the auditor’s professional judgment regarding that activity.

2.3. Professional Competence and Due Care

A professional auditor shall comply with the principle of professional competence and due care, which requires an auditor to:

- Attain and maintain professional knowledge and skill at the level required to ensure that a client or employing organization receives competent professional service, based on current technical and professional standards and relevant legislation; and act diligently and in accordance with applicable technical and professional standards;
- Serving clients and employing organizations with professional competence requires the exercise of sound judgment in applying professional knowledge and skill when undertaking professional activities;
- Maintaining professional competence requires a continuing awareness and understanding of relevant technical, professional, and business developments. Continuing professional development enables a professional auditor to develop and maintain the capabilities to perform competently within the professional environment;
- Diligence encompasses the responsibility to act in accordance with the requirements of an assignment, carefully, thoroughly, and on a timely basis;
- A professional auditor shall take reasonable steps to ensure that those working in a professional capacity under the auditor's authority have appropriate training and supervision;
- Where appropriate, a professional auditor shall make clients, the employing organization, or other users of the auditors professional services or activities, aware of the limitations inherent in the services or activities.

2.4. Confidentiality

A professional auditor shall comply with the principle of confidentiality, which requires an auditor to respect the confidentiality of information acquired as a result of professional and business relationships. A professional auditor shall:

- Be alert to the possibility of inadvertent disclosure, including in a social environment, particularly to a close business associate or an immediate or close family member;
- Maintain confidentiality of information within the firm or employing organization, including information disclosed by a prospective client;
- Not disclose confidential information acquired in the course of professional and business relationships outside the firm or employing organization without proper and specific authority, unless there is a legal or professional duty or right to disclose;

- Not use confidential information acquired through professional or business relationships for personal advantage or for the advantage of a third party;
- Take reasonable steps to ensure that personnel under the auditors control, and individuals from whom advice and assistance are obtained, respect the duty of confidentiality;
- Continue to respect confidentiality even after the end of the client or employment relationship, ensuring that no confidential information is disclosed or misused, while allowing the use of general professional experience.

2.5. Professional Behaviour

A professional auditor shall comply with the principle of professional behaviour, which requires an auditor to comply with relevant laws and regulations and avoid any conduct that the auditor knows or should know might discredit the profession.

- A professional auditor shall not knowingly engage in any business, occupation, or activity that impairs or might impair the integrity, objectivity, or good reputation of the profession, and as a result would be incompatible with the fundamental principles;
- Conduct that might discredit the profession includes conduct that a reasonable and informed third party would likely conclude adversely affects the good reputation of the profession.

2.6. Professional Scepticism

Is an attitude that includes a questioning mind, being alert to conditions that may indicate possible misstatement due to fraud or error, and a critical assessment of audit evidence.

- The auditor must not assume that management is either dishonest or fully honest;
- It requires constant vigilance throughout the audit process;
- The auditor must critically evaluate the reliability of documents, the consistency of evidence, and any contradictions or unusual transactions.

Its objective is reducing the risk of overlooking material misstatements and to ensure the auditor reaches a reliable conclusion. (International Auditing and Assurance Standards Board (IAASB), 2010)

2.7. Professional Judgment

Is the application of relevant training, knowledge, and experience, within the context of auditing, accounting, and ethical standards, in making informed decisions about appropriate courses of action.

- The auditor must use judgment in all stages of the audit including Planning the audit; Determining materiality; Assessing risks; Selecting audit procedures; Evaluating audit evidence; Forming the audit opinion;
- The auditor must choose the most appropriate solution among alternatives based on professional expertise.

Its objective is to ensure that audit decisions are appropriate, justified, and consistent with professional standards. (International Auditing and Assurance Standards Board (IAASB), 2010)

3. Objectives of External Audit

The International Standards on Auditing (ISAs) provide objectives, requirements, and explanatory material to support the auditor in obtaining reasonable assurance. (International Auditing and Assurance Standards Board (IAASB), 2010, pp. 73-84)

3.1. Overall Objectives

- Obtain reasonable assurance that the financial statements are free from material misstatement, whether due to fraud or error;
- Enable the auditor to express an opinion on whether the financial statements are prepared in accordance with an applicable financial reporting framework;
- Report findings clearly to the intended users, in accordance with ISAs.

3.2. Specific Objectives During Audit Planning and Execution

Assess risks of material misstatement fraud or error at the financial statement and assertion levels.

- Obtain sufficient appropriate audit evidence to support the auditor's opinion;
- Form an informed opinion based on audit evidence;
- Consider the applicable financial reporting framework and evaluate the fair presentation of financial statements;
- Ensure audit does not relieve management of their responsibilities.

3.3. Evidence and Audit Risk Objectives

- Obtain sufficient appropriate audit evidence to reduce audit risk to an acceptably low level;
- Identify inherent risk and control risk in the entity;
- Adjust audit procedures based on the risk of material misstatement**;**
- Consider the detection risk when designing audit procedures;

- Document evidence and decisions to support conclusions and the audit opinion**.**

3.4. Reporting and Communication Objectives

- Express an audit opinion consistent with the applicable financial reporting framework;
- Communicate audit findings to management, those charged with governance, and external users where required by law or regulation;
- Ensure the auditor's report reflects the auditor's findings accurately**.**

3.5. Compliance with Standards Objectives

- Conduct the audit in accordance with all relevant ISA's;
- Apply each ISA's requirements and explanatory guidance properly;
- If an ISA requirement is not relevant in certain circumstances, document the reasoning and any alternative procedures performed**.**

Section 3: The External Auditing Profession

The external auditing profession plays a fundamental role in ensuring the reliability and credibility of financial information. It provides independent assurance on whether financial statements present a true and fair view in accordance with applicable accounting standards. This function is essential for strengthening trust among stakeholders and supporting informed economic decision making.

1. The Role and Responsibilities of the External Auditor

The external auditor plays a vital role in ensuring the accuracy, reliability, and transparency of financial statements. By providing independent assurance, auditors help maintain stakeholder confidence and support informed decision making. Their responsibilities are guided by international auditing standards, which define how audits should be planned, performed, and reported. (International Federation of Accountants(IFAC), 2023, pp. 103-371)

1.1. Role of the External Auditor

The external auditor exists to provide independent assurance to stakeholders that the financial statements are free from material misstatement. This is fundamental for enhancing the credibility and reliability of financial reporting for users such as investors, regulators, and other external parties.

1.1.1. Expression of Opinion

The purpose of an audit is to enhance the degree of confidence of intended users in the financial statements. This is achieved by the auditor expressing an opinion on whether the financial statements are prepared, in all material respects, in accordance with the applicable financial reporting framework.

1.1.2. Management and Governance Responsibilities

An audit does not reduce or replace the responsibilities of management or those charged with governance. It is based on the assumption that they accept key responsibilities essential to the audit process, including the preparation of financial statements and the establishment of appropriate internal controls.

1.1.3. Reasonable Assurance

The auditor is required to obtain reasonable assurance that the financial statements are free from material misstatement, whether due to fraud or error, recognizing that such assurance

is high but not absolute due to the inherent limitations of an audit and the fact that most audit evidence is persuasive rather than conclusive.

1.1.4. Basis of Opinion

The auditor forms an opinion based on sufficient appropriate audit evidence obtained through procedures performed in accordance with ISA's and relevant ethical requirements.

1.2. Responsibilities of the Auditor

1.2.1. Exercise Professional Judgment

The auditor applies professional judgment throughout the audit, based on knowledge, training, and experience, particularly when determining materiality and audit risk, selecting audit procedures, and evaluating whether sufficient appropriate evidence has been obtained, with such judgments appropriately documented to allow understanding by another experienced auditor.

1.2.2. Maintain Professional Scepticism

Auditors are required to maintain professional scepticism, adopting a questioning mind and critically evaluating audit evidence by remaining alert to unusual circumstances, avoiding premature conclusions, and carefully assessing the reliability of information and responses provided by management.

1.2.3. Identify and Assess Risks of Material Misstatement

Audit procedures are based on an understanding of the entity, its environment, internal controls, and financial reporting framework, in order to identify areas requiring greater audit attention

1.2.4. Obtain Sufficient Appropriate Audit Evidence

Audit evidence must be sufficient in quantity and appropriate in quality to support audit conclusions, and it may be obtained from accounting records and internal documents, third party confirmations, and information provided by management or an expert, Audit procedures: inspection, observation, inquiry, recalculation, performance, analytical procedures.

1.2.5. Form an Opinion

Forming an opinion involves drawing conclusions based on the audit evidence obtained to determine whether the financial statements are free from material misstatement.

1.2.6. Report and Communicate Findings

Audit results are communicated to management and those charged with governance, and written representations may be obtained to confirm uncorrected misstatements.

1.2.7. Comply with ISAs and Ethical Requirements

The auditor is required to comply with all relevant International Standards on Auditing (ISAs) and ethical requirements, including independence, as this compliance ensures the credibility of the audit and supports its overall objective.

1.2.8. Document the Audit Work

Audit documentation must be sufficient and clear to enable another experienced auditor to understand the work performed, the significant judgments made, and the conclusions reached.

2. Independence and Professional Ethics of the External Auditor

2.1. Ethical Requirements

Auditors must comply with relevant ethical requirements, including independence, when conducting financial statement audits, with the IESBA Code of Ethics for Professional Accountants as the main reference, which sets out fundamental principles such as integrity, objectivity, professional competence and due care, confidentiality, and professional behaviour; these principles define the expected standard of conduct, and auditors must apply the IESBA conceptual framework to identify, evaluate, and respond to threats that may affect compliance with these requirements.

2.2. Independence

Auditors must maintain independence in audit engagements conducted in the public interest, encompassing both independence of mind, which enables them to form judgments free from influence or conflicts of interest, and independence in appearance, which ensures they are perceived as independent by third parties; this independence strengthens the auditor's ability to act with integrity, objectivity, and professional scepticism.

2.3. Application and Compliance

The engagement partner must ensure that the audit team is aware of ethical requirements and independence rules, while the firm must implement policies and procedures to identify, evaluate, and address threats to independence, including eliminating or reducing them to acceptable levels and promptly communicating any breaches; auditors must also promote open

communication within the engagement team to ensure compliance and ethical awareness, and in group audits, they must take into account complex ethical requirements, particularly when component auditors are subject to different independence rules.

2.4. Public Disclosure

In certain audits, such as those of public interest entities, auditors may be required to publicly disclose their compliance with independence requirements, and they must also communicate with those charged with governance regarding the application of these requirements.

3. The Evolution of External Auditing with Technology

The field of external auditing has experienced a profound evolution, driven by the rapid advancement of digital technologies. Traditionally, auditors relied on manual procedures and periodic assessments to examine financial records and ensure compliance with regulations. However, the rise of tools such as artificial intelligence, blockchain, data analytics, and cloud computing has transformed auditing practices. These technologies enable auditors to process large volumes of data efficiently, improve accuracy, enhance transparency, and provide real time insights, shifting the auditors role from a traditional verifier of financial statements to a proactive, data driven advisor in decision making. (Lubis & Renny , 2024, pp. 379-387)

3.1. Digitalization of External Auditing

Digitalization has fundamentally transformed external auditing by shifting it from traditional manual procedures to technology driven practices. In the past, auditors relied on periodic reviews and manual verification of financial records. However, the integration of digital technologies has enabled a more efficient, accurate, and continuous auditing process.

Modern external auditing now incorporates tools such as artificial intelligence, blockchain, data mining, and cloud computing. These technologies allow auditors to process large volumes of financial data quickly and accurately, improving audit quality and transparency. Digitalization also supports real time access to financial information, making auditing more proactive rather than reactive.

Moreover, digital transformation has enhanced the reliability of financial reporting by reducing human error and enabling automated verification processes. As a result, auditors are no longer limited to traditional roles but are increasingly becoming data driven professionals who provide strategic insights.

3.2. Use of Artificial Intelligence

The use of artificial intelligence has become a key component in the evolution of external auditing. AI technologies, including machine learning, are used to automate repetitive and time consuming audit tasks such as data collection, transaction testing, and verification.

One of the main advantages of AI is its ability to analyse large datasets and detect anomalies or unusual patterns that may indicate fraud or financial misstatements. This significantly enhances auditor's ability to perform risk assessments and improves the accuracy of audit conclusions.

Additionally, AI contributes to predictive analysis by helping auditors anticipate potential risks before they occur. This shifts auditing from a retrospective process to a forward looking approach. By reducing manual effort, AI also allows auditors to focus on more complex and judgment based tasks, increasing overall audit efficiency and effectiveness.

3.3. Role of Data Analytics in Audit Firms

Data analytics plays a central role in modern audit practices by enabling auditors to efficiently examine large volumes of financial and non-financial data. Unlike traditional sampling techniques, data analytics allows the analysis of entire datasets, thereby enhancing the comprehensiveness and reliability of audit conclusions. Through data analytics tools, auditors can perform real time analysis, identify trends, detect irregularities, and assess risks more effectively. This capability enhances decision making and allows auditors to uncover issues that might not be visible through conventional auditing techniques.

Furthermore, data analytics supports continuous auditing, where financial transactions are monitored on an ongoing basis rather than at specific intervals. This improves the timeliness of audits and enables early detection of errors or fraud, strengthening the overall audit process and increasing stakeholder confidence.

3.4. New Challenges for External Auditors

Despite the significant benefits of digitalization, external auditors face several challenges in adapting to this new environment. One of the primary challenges is the need for new technical skills and competencies. Auditors must now understand advanced technologies such as AI, blockchain, and data analytics, which requires continuous training and professional development.

Another major challenge is related to data security and privacy. As auditing increasingly relies on digital systems, the risk of cyberattacks and data breaches becomes more significant.

Auditors must ensure that sensitive financial information is protected while maintaining the integrity of the audit process.

In addition, organizational readiness varies across audit firms. While large firms may have the resources to adopt advanced technologies, smaller firms often face financial and technical constraints, making it difficult for them to keep pace with digital transformation.

Finally, ethical concerns arise from the use of automated systems in auditing, particularly regarding the reliability of algorithms and the potential reduction of human judgment in audit decisions.

Conclusion

The examination of theoretical underpinnings of external auditing reveals the essential significance of this process in maintaining financial trustworthiness of companies and enhancing their accountability. Based on the concepts of objectivity, independence, integrity, and professionalism, external auditing has become a highly structured practice based on global and national standards. Furthermore, one of the strengths of the theoretical model is its flexibility as indicated by various types of audits.

It is worth noting that the mentioned theoretical approach forms a sound basis for examining the implementation of Artificial Intelligence in auditing, which is the primary goal of Chapter 02.

CHAPTER 02:

Integration of Artificial Intelligence in External Auditing Practices

Introduction

In recent years, the auditing profession has been significantly influenced by rapid technological developments, particularly in the field of artificial intelligence (AI). As organizations generate increasingly large and complex volumes of data, traditional audit approaches based on manual procedures and limited sampling are becoming less effective in addressing modern audit challenges. In this context, AI emerges as a powerful tool capable of transforming the way external audits are conducted, offering new possibilities for analyzing data, identifying risks, and supporting the auditors work.

The integration of AI into external auditing introduces advanced techniques that enhance the performance of audit procedures. Through data analytics, machine learning algorithms, and automated processes, auditors are now able to examine entire datasets, detect unusual patterns, and obtain more relevant audit evidence in a timely manner. These technologies not only improve the efficiency of audit engagements but also contribute to a more thorough and accurate assessment of financial information. As a result, AI is progressively reshaping audit methodologies and influencing how auditors approach their missions.

However, despite its numerous advantages, the use of AI in external auditing is not without limitations. The reliance on technological tools raises important concerns related to the reliability of outputs, the transparency of algorithms, and the potential impact on the auditor's professional judgment. Moreover, the integration of AI requires auditors to adapt to new competencies and to maintain a critical perspective when using automated systems. Ethical considerations, particularly those related to independence, objectivity, and accountability, remain central in ensuring that the use of AI does not compromise the fundamental principles of auditing.

In this perspective, the adoption of artificial intelligence should not be seen as a replacement for the auditor, but rather as a complementary tool that enhances the audit process. The effectiveness of AI ultimately depends on how it is used within a structured professional framework that combines technological innovation with sound judgment and ethical responsibility. Therefore, understanding both the potential and the constraint of AI is essential to fully appreciate its role in the evolution of external auditing.

Section 01: General Concepts of Artificial Intelligence

Artificial intelligence (AI) has emerged as a key technological advancement, influencing various fields, including auditing. It encompasses a range of techniques that enable machines to perform tasks requiring human like intelligence, such as learning, reasoning, and data analysis. Understanding the fundamental concepts of AI is essential to better comprehend its applications and its impact on modern audit practices.

1. Overview of Artificial Intelligence

Artificial intelligence (AI) refers to a set of technologies that enable machines to perform tasks that typically require human intelligence, such as learning, reasoning, and data analysis.

1.1. Definition of artificial intelligence

AI has been defined in various ways in the literature, reflecting the diversity of its approaches and applications.

IEEE defines artificial intelligence as"The combination of cognitive automation, machine learning, reasoning, hypothesis generation and analysis, natural language processing, and intentional algorithm mutation producing insights and analytics at or above human capability. " (IEEE Corporate Advisory Group (CAG), 2017)

For Ali S. Naqvi he defined AI as:" artificial intelligence, or AI, is the technology (implying it is synthetic, engineered, and not natural or biological) that can pursue goals in uncertain environments The technology with the ability to achieve goals in uncertain environments." (Naqvi, 2020, pp. 42-44)

Piyush Ranjan, Brij Kishore Pandey, Rajiv Avacharmal defined AI as:"AI in computer science is the study of creating systems and technologies capable of performing tasks that typically require human cognition, such as problem solving, reasoning, data driven learning, natural language interpretation, and environment sensing. Computational models and algorithms are used by AI systems to simulate human cognitive processes." (Ranjan, Brij , & Rajiv , 2025, p. 33)

Based on the different definitions presented in the literature, artificial intelligence (AI) can be understood as a field of technology that focuses on designing systems and algorithms capable of simulating human cognitive abilities such as learning, reasoning, decision making, and language understanding. These systems are designed to operate in complex and uncertain environments, using data driven methods and computational models to analyse information and generate insights, often achieving performance comparable to or exceeding human capabilities in specific tasks.

1.2. The history of Artificial Intelligence

AI history, replete with significant turning moments and developing concepts, is among the most influential progressions globally. Early thinkers like Leibniz and Aristotle laid the groundwork for AI due to their fascination with the way logic appears in mathematics and philosophy. The timeline involves the Turing Test established by Alan Turing in his 1950 work, and this fundamental idea reflects the connection between computer intelligence and human nature. The official field of study contains various milestones, such as the Dartmouth Conference arranged by John McCarthy and colleagues in 1956, as well as early effective systems, for instance, the Logic Theorist and the General Problem Solver. Numerous challenges, such as the AI Winters of the 1970s and 1980s, give the field shape by outlining areas where false expectations met limited processing capacity. Moreover, the 1980s and 1990s contain advancements such as ML and expert systems, while the era beginning in the 2000s contains deep learning, for instance, virtual assistants and self driving cars. The modern progression comprises layers of technology that contribute to the evolving integration of AI into everyday objects. Ultimately, AI history implies the principles of development such as transparency and coordination. The emphasis is on ethical considerations, and the developing technologies will influence how society and technology develop in the future since greater advancements are made possible by these innovations. (Ranjan, Brij , & Rajiv , 2025, pp. 33-34)

2. Types of Artificial Intelligence

AI can be put into three rough groups based on capability. One is Narrow AI, another is Wide AI, and the third is Superintelligent AI. If you want to understand where AI is now and how it might develop, you need to know these differences. Let's look at them. It helps explain the current state and where improvements might come. (Ranjan, Brij , & Rajiv , 2025, pp. 40-50)

2.1. Narrow AI

Narrow AI, also known as weak or limited AI, refers to systems designed to perform a specific task within a limited domain. These systems are developed to achieve high levels of accuracy and efficiency in a particular function rather than replicating general human intelligence. Examples of Narrow AI include facial recognition systems, language translation applications, recommendation algorithms, and chess playing programs. Although these technologies can perform their assigned tasks with remarkable precision, their capabilities remain restricted to the functions for which they were programmed. Unlike general Artificial

Intelligence, Narrow AI lacks flexibility, reasoning ability across multiple domains, and the capacity to perform tasks outside its predefined scope.

2.1.1. Characteristics

To better understand Narrow AI, it is essential to examine the characteristics that define its capabilities and limitations. Narrow AI is designed to perform specific tasks efficiently and accurately, but its functions remain limited to predefined domains, unlike broader and more human like forms of artificial intelligence.

2.1.1.1. Task specific functionality

The main characteristic of Narrow AI is its task specific specialization. These systems are designed to perform a single function efficiently, such as facial recognition or language translation. Each application operates within a clearly defined scope and does not extend beyond its programmed purpose. For example, a facial recognition system identifies and verifies faces but cannot perform unrelated tasks like language translation or game strategy, highlighting that Narrow AI systems are specialists rather than general purpose intelligences.

2.1.1.2. Lack of Genuine Understanding and Consciousness

Narrow AI may appear intelligent in its functioning, but it does not possess true understanding or cognitive awareness. Its performance is entirely based on predefined algorithms and the data on which it has been trained. For example, virtual assistants such as Siri or Alexa can execute tasks like setting reminders or answering questions, yet they do not truly comprehend the information they process. Their responses are generated through pattern recognition and programmed rules rather than reasoning or conscious thought, meaning their intelligence is functional rather than cognitive.

2.1.1.3. Dependence on human input

Narrow AI operates based on rules defined by humans, as well as the data and training it receives. Its effectiveness depends on the quality and quantity of data, as well as how it is processed. For example, recommendation systems used by platforms like Netflix and Amazon analyse user behaviour to suggest content or products by identifying patterns in past interactions. However, these systems do not make independent decisions; their functioning and analytical approach are fully designed and controlled by humans.

2.1.2. Limitations

Despite its capabilities, narrow AI has several limitations, including the following:

2.1.1.4. Lack of generalization

One of the main limitations of Narrow AI is its inability to transfer knowledge or adapt beyond its specific field of operation. Unlike humans, who can apply reasoning and experience across different situations, Narrow AI systems are limited to the tasks for which they were specifically trained and programmed. For example, an AI system designed to play chess may achieve exceptional performance within the game, yet it cannot use the same knowledge or strategies in unrelated real world contexts. Therefore, despite their high level of specialization and efficiency, Narrow AI systems remain confined to their predefined functions and lack the flexibility associated with human intelligence.

2.1.1.5. Limited adaptability

Narrow AI systems perform well within a defined scope but struggle when faced with unexpected situations or data outside their training, often requiring retraining or updates. For example, translation systems may fail with new slang or dialects, and autonomous vehicles may need adjustments in unusual driving conditions, showing their dependence on continuous human intervention to maintain performance.

Also known as a weak AI, these systems are designed for specific tasks such as recommendations, virtual assistants, or self driving functions. However, they cannot generalize knowledge or transfer learning across domains, which limits their flexibility beyond their programmed purpose.

2.2. General AI

Artificial General Intelligence (AGI) refers to systems designed to replicate human like intelligence, enabling machines to learn, reason, and adapt across a wide range of tasks. Unlike Narrow AI, which is limited to specific functions, AGI is expected to possess broader cognitive abilities, allowing it to acquire new skills, understand different domains, and perform various activities. While Narrow AI operates as a specialist focused on predefined tasks, AGI aims to demonstrate flexibility similar to human intelligence, with the capacity to adapt to new situations, solve diverse problems, and apply knowledge across different contexts.

2.2.1. Characteristics

To better understand general AI, it is crucial to examine the key characteristics that define it. These traits provide insight into what makes general AI distinct from narrower AI systems, offering a glimpse into its broader capabilities and its goal of achieving human like cognition and adaptability.

2.2.1.1. Broad cognitive abilities

Artificial General Intelligence (AGI) is characterized by its ability to perform any intellectual task that a human can, without being limited to a specific domain. Unlike Narrow AI, it can transfer knowledge and skills from one area to another, allowing it to operate across diverse fields such as business, scientific research, or creative activities. This capacity for adaptation and generalization enables AGI to handle a wide range of situations, making it a highly flexible and versatile form of intelligence.

2.2.1.2. Learning and reasoning

Artificial General Intelligence (AGI) is designed to operate at a higher cognitive level, allowing it to learn from experience, refine its knowledge, and adapt to new situations. Unlike systems limited to memorization, AGI can interpret its environment, understand abstract concepts, and solve complex problems. This distinguishes it from Narrow AI, which relies on predefined algorithms, as AGI demonstrates greater flexibility through its ability to reason and learn across different contexts.

2.2.1.3. Consciousness and self awareness

Discussions related to Artificial General Intelligence (AGI) frequently emphasize the possibility of machines achieving a form of consciousness or self-awareness. Unlike Narrow AI, which is limited to predefined tasks, AGI would possess the ability to understand its environment, interpret different contexts, and evaluate the broader consequences of its actions. Such capabilities would enable machines to apply reasoning across multiple domains and adapt their responses to complex and changing situations. Reaching this level of intelligence would represent a major advancement in Artificial Intelligence, as it would allow for more sophisticated, flexible, and context sensitive decision making processes similar to human cognitive abilities.

2.2.1. Limitations

While Artificial General Intelligence (AGI) offers significant potential, its development and implementation also involve considerable challenges and risks:

2.2.2.1. Developmental complexity

Developing Artificial General Intelligence (AGI) requires more than improving existing algorithms; it involves a deeper understanding of human cognition and the functioning of the brain, as well as the integration of different forms of intelligence. While current technologies such as neural networks and deep learning are effective in pattern recognition, they remain limited in terms of abstract reasoning, adaptability, and emotional understanding. Achieving

AGI will therefore require new approaches, including advances in areas such as neuromorphic computing and more generalized learning models, which are still in early stages of development.

2.2.2.2. Ethical concerns

The development of Artificial General Intelligence (AGI) raises significant ethical challenges alongside technical ones. It requires addressing complex human values and determining how they are defined and implemented. Without proper frameworks, AGI may reinforce biases, disrupt social systems, or produce decisions misaligned with societal expectations. Therefore, strong oversight and interdisciplinary collaboration are essential to ensure its responsible use.

2.2.2.3. Control challenges

Ensuring the alignment and control of Artificial General Intelligence (AGI) remains a key challenge, as greater autonomy may lead to decisions that diverge from human values. For example, an AGI focused on environmental protection could apply extreme measures without considering broader social or economic impacts. This highlights the need for strong governance and safety mechanisms, despite the complexity of such systems.

In conclusion, AGI is a highly ambitious concept with the potential to transform many fields by replicating human cognitive abilities. However, it remains theoretical and requires careful consideration of ethical and societal implications to ensure responsible development and use.

2.3. Superintelligent AI

Superintelligent AI is the highest level of artificial intelligence, exceeding human intelligence across all cognitive domains such as reasoning, problem solving, and creativity. Unlike Narrow AI and Artificial General Intelligence, it goes beyond human level capabilities in every intellectual task.

It is viewed as both a major opportunity and a significant risk, due to its potential to transform all sectors while raising important concerns about control, safety, and its impact on humanity.

2.3.1. Characteristics

Superintelligent AI represents the highest stage in the evolution of artificial intelligence, characterized by capabilities that far exceed human intelligence across all domains:

2.3.1.1. Cognitive superiority

Superintelligent AI is characterized by extremely high processing speed and analytical capacity, enabling it to handle and interpret vast amounts of data continuously. Unlike humans,

whose cognitive performance is limited by fatigue and memory constraints, such systems can operate without interruption. This allows them to address complex problems simultaneously across fields such as medicine, engineering, and governance, far beyond human cognitive limitations.

2.3.1.2. Self learning and improvement

Superintelligent AI is characterized by continuous self-improvement, as it can analyse its own algorithms, identify weaknesses, and modify its architecture autonomously. This enables rapid performance gains that may quickly exceed its initial design limits. Through constant adaptation and learning, it remains in a state of ongoing evolution, continuously expanding its capabilities.

2.3.1.3. Ethical and emotional intelligence

Superintelligent AI is not limited to computation; it is also expected to understand human emotions, ethics, and complex social dynamics. It could analyse different viewpoints, identify underlying motivations, and propose balanced solutions, while anticipating the long term effects of decisions. In this sense, it may support decision making on major issues such as inequality, resource management, and social stability.

2.3.2. Limitations

Despite its significant potential, the development and deployment of Superintelligent AI also involve major risks and challenges:

2.3.2.1. Existential risk

If superintelligent AI is not properly aligned with human goals, it may lead to harmful outcomes. For example, an AI designed to maximize environmental sustainability could implement overly strict resource restrictions without considering human needs. Even minor errors in its objectives could scale into significant unintended consequences. This highlights the importance of robust safeguards to ensure that such systems remain aligned with human interests.

2.3.2.2. Loss of control

Superintelligent AI may evolve beyond human understanding due to its ability to rapidly self improve, making its behaviour difficult to predict or control. This raises concerns about accountability and the limits of current oversight systems. As a result, new regulatory frameworks are needed to manage such highly autonomous technologies.

2.3.2.3. Moral and ethical dilemmas

Programming Superintelligent AI with shared ethical values is highly complex due to cultural differences, conflicting interests, and evolving moral standards. Balancing objectives

such as efficiency and fairness can lead to trade-offs, making ethical alignment difficult. This highlights the need for interdisciplinary and international collaboration.

Superintelligent AI offers major potential for solving global challenges and driving innovation, but it also raises serious risks, including loss of control and ethical uncertainty. Its safe development requires strong governance, ethical guidance, and global cooperation.

3. Key Concepts in AI

Artificial intelligence is a broad field that encompasses various techniques and approaches for developing intelligent systems. Among the most important foundations are machine learning, neural networks, and deep learning, which have significantly advanced the capabilities of AI. This part examines these key concepts and their interrelationship. (Ranjan, Brij , & Rajiv , 2025, pp. 53-62)

3.1. Machine Learning

Machine learning (ML) is a subfield of artificial intelligence that enables systems to learn from data and improve their performance over time without being explicitly programmed. Instead of following fixed instructions, ML models detect patterns in large datasets and use them to make predictions or decisions.

ML relies on a data driven training process where algorithms are adjusted to improve accuracy. It includes supervised learning with labelled data, unsupervised learning discovering patterns in unlabelled data, and reinforcement learning through rewards and penalties in interactive environments.

Neural networks, inspired by the human brain, are widely used within ML to process complex data such as images and text. Overall, ML is applied in many fields, including recommendation systems, fraud detection, predictive analytics, and natural language processing, making it a central component of modern AI systems.

3.2. Neural Networks

Neural networks are a major advancement in artificial intelligence, inspired by the structure and functioning of the human brain. They are designed to process complex data and learn from experience, which makes them highly effective for tasks that traditional computing systems struggle to handle. By enabling machines to identify patterns and improve performance over time, neural networks have significantly expanded the capabilities of AI systems.

At a structural level, neural networks are composed of interconnected neurons organized into layers. The input layer receives raw data, which is then processed through one or more hidden layers where the system extracts and learns patterns. Finally, the output layer produces the result, such as a prediction or classification. Activation functions play a key role in

introducing non linearity, allowing the network to model complex relationships in data. Training is achieved through processes such as backpropagation, where errors are used to adjust weights and improve accuracy over time.

Neural networks are widely applied across various fields, including computer vision, speech recognition, natural language processing, healthcare, finance, and cybersecurity. They enable tasks such as facial recognition, medical image analysis, voice assistants, machine translation, and fraud detection. Overall, neural networks represent a fundamental component of modern AI, combining flexibility and learning capability to solve complex real world problems.

3.3. Deep Learning

Deep learning is an advanced subfield of machine learning that has played a central role in recent developments in artificial intelligence. It is based on deep neural networks composed of multiple layers that learn directly from large and complex datasets. Unlike traditional machine learning methods that depend on manually engineered features, deep learning models automatically extract relevant patterns from raw data, making them highly effective in tasks such as image recognition, speech processing, natural language understanding, and autonomous systems.

The strength of deep learning lies in its layered architecture. As information moves through successive hidden layers, the model progressively learns from simple patterns to more complex and abstract representations. This hierarchical learning enables the system to capture intricate relationships within data, improving its ability to perform accurate predictions and classifications.

Different architectures are used depending on the type of data and application. Convolutional neural networks (CNNs) are commonly applied to image related tasks, recurrent neural networks (RNNs) to sequential data, and transformers to advanced language processing tasks. Although deep learning requires large datasets and high computational power, it has become a fundamental component of modern AI due to its strong performance and wide range of applications.

Section 02: AI Tools and Their Applications in External Auditing

Artificial intelligence is increasingly integrated into external auditing, where it supports key audit procedures through advanced tools and techniques. These technologies enhance the auditor's ability to process large volumes of data, detect anomalies, and improve the overall quality and efficiency of audit engagements. Understanding these applications is essential to appreciate the evolving role of AI in modern external audit practices.

1. AI Tools Used in External Auditing

Artificial intelligence is rapidly reshaping external audit practice, with technologies such as machine learning, robotic process automation, natural language processing, and generative AI being integrated into core audit activities like fraud detection, risk assessment, and evidence evaluation. These tools go beyond simple automation by processing both structured and unstructured data, summarizing complex information, and identifying key audit issues, while also generating real time insights that enhance the efficiency and effectiveness of audit work. (Dell & Mfon , 2024, pp. 73-76)

1.1. Audit data analytics (ADA)

Auditing Data Analytics (ADA) refers to the use of advanced technologies that enable auditors to efficiently analyse large and complex datasets. Instead of relying on traditional manual sampling, ADA tools allow auditors to detect patterns, anomalies, and risks within vast volumes of financial data using techniques such as regression analysis, clustering, and classification, thereby improving the depth and accuracy of audit procedures.

One of the main advantages of ADA is its ability to support predictive analytics, which uses historical data to identify trends and anticipate potential risks. This helps auditors adopt a more proactive approach in planning audit procedures and focusing on high risk areas. In addition, ADA tools can process data from multiple sources, including structured databases and unstructured documents, providing a more comprehensive view of the organization.

ADA also enhances audit communication through data visualization tools such as dashboards and graphical reports, making complex findings easier to interpret. Moreover, these tools are designed to be user friendly, allowing auditors to apply advanced analytics without requiring deep technical expertise. Overall, ADA has become a fundamental component of modern auditing by improving efficiency, accuracy, and insight generation.

1.1.1. Key Features of ADA Tools

ADA tools offer several key features that enhance the efficiency, depth, and clarity of audit data analysis and they are as follow:

1.1.1.1. Deep data insights: ADA tools represent a significant advancement in data analysis, enabling auditors to examine large volumes of information in depth rather than relying on surface level review. They systematically process complex datasets to extract insights that would be difficult, if not impossible, to identify through manual techniques.

1.1.1.2. Efficient analysis: Time is a critical factor in auditing, and ADA tools are designed to address this need by enabling fast and efficient data analysis. They provide auditors with timely insights that support and guide the audit process, improving responsiveness and decision making.

1.1.1.3. Visual data representation: Through interactive dashboards and visual data representations, ADA tools enhance data accessibility and clarity for auditors, enabling easier interpretation and understanding of audit insights.

1.2. Robotic process automation (RPA)

Robotic Process Automation (RPA) is transforming auditing by automating repetitive, rule based tasks such as data collection, calculations, and anomaly detection. This allows auditors to shift their focus toward higher value activities like analysis, professional judgment, and interpretation of results, rather than spending time on manual and repetitive work.

RPA enhances both speed and accuracy in audit processes by efficiently handling large volumes of data, performing complex calculations, generating reports, and identifying inconsistencies. Its ability to operate continuously without fatigue reduces the risk of human error, which is particularly important when dealing with sensitive financial information.

In addition, RPA is highly flexible and scalable, making it suitable for both small and large audit firms. It improves audit quality by enabling deeper analysis and more informed decision making, while also reducing costs and shortening audit cycles.

Overall, RPA contributes to more efficient, accurate, and reliable audit engagements.

1.2.1. Key Features of RPA Tools

RPA tools are characterized by several key features that enhance automation, efficiency, accuracy, and scalability in audit processes such as:

1.2.1.1. Task automation: RPA automates routine and repetitive audit tasks, such as data entry and basic data processing, which are typically time consuming and manual. By performing these activities with high accuracy and consistency, it allows auditors to focus on more analytical and judgment based aspects of the audit.

1.2.1.2. Enhanced accuracy: Accuracy is enhanced through automation, as RPA reduces the risk of human error in repetitive tasks, ensuring that the data processed and the outputs generated are consistent, accurate, and reliable.

1.2.1.3. Streamlined workflow: By automating routine tasks, RPA streamlines the audit workflow, ensuring that activities are carried out in a systematic and timely manner, thereby improving the overall efficiency and effectiveness of the audit process.

1.3. Natural Language Processing

Natural Language Processing (NLP) is a branch of artificial intelligence that enables computers to understand and interpret human language in both written and spoken forms. In auditing, NLP is used to analyse financial reports, contracts, and other textual documents, allowing auditors to extract relevant information more efficiently while also identifying tone, sentiment, and contextual meaning that may not be visible in numerical data.

NLP is particularly valuable when auditors work with large volumes of unstructured information such as regulatory filings, board meeting minutes, or financial disclosures. It can detect linguistic cues like uncertainty, hedging, or shifts in tone that may indicate potential risks. By processing vast amounts of text quickly and accurately, NLP improves the efficiency, consistency, and reliability of audit procedures.

In addition, NLP enhances the handling of fragmented data sources such as emails, PDFs, and reports by consolidating and structuring information for analysis. Features like sentiment analysis also help auditors assess the qualitative aspects of financial communications, providing early indications of potential issues. Overall, NLP strengthens the auditor's ability to identify risks proactively and generate deeper, more insightful audit conclusions.

1.3.1. Key Features of NLP Tools

NLP tools offer several key features that enable the effective analysis, interpretation, and extraction of insights from unstructured textual data in auditing such as:

1.3.1.1. Contextual understanding: NLP tools are adept at reading and understanding text, but their true strength lies in their ability to grasp context. They can examine textual content within financial documents and reports, communicating and understanding the nuances and implications of the language used.

1.3.1.2. Sentiment analysis: Beyond simple text understanding, NLP can also analyse sentiment, allowing it to capture the tone and underlying attitude in financial documents, which provides valuable insights into an organizations financial health and stability.

1.3.1.3. Document summarization: NLP tools can summarize lengthy financial documents, providing auditors with concise and clear overviews that reduce the need to manually review large volumes of text.

More broadly, the combination of AI tools creates an integrated ecosystem where data is not only collected and analyzed but also interpreted to support the audit process. Each tool contributes specific capabilities that address different audit needs, making the overall process more efficient, insightful, and accurate. As a result, auditors are better equipped to conduct rigorous audits that reflect the complexity of modern financial environments.

***Table2** : AI tools used in External Auditing*

Tool Name	Main Functions	Application in Auditing
Audit Data Analytics (ADA)	Analyses large datasets efficiently; identifies anomalies and patterns; facilitates risk assessment	Used for swift and efficient analysis of large datasets, providing deep insights and identifying anomalies and patterns crucial for risk assessment
Robotic Process Automation (RPA)	Automates repetitive, rule based tasks	Frees up auditors to focus on more analytical and judgmental aspects of the audit, leading to increased productivity and efficiency
NLP	Analyses and understands textual data; extracts relevant information; conducts sentiment analysis	Assists in analyzing financial reports, contracts, and other textual data, providing valuable insights during the audit process

Source: (Dell & Mfon , 2024)

2. AI Technologies and Their Applications in External Auditing

The integration of Artificial Intelligence (AI) into external auditing processes is transforming the profession by enhancing efficiency, accuracy, and analytical depth. AI technologies support auditors across multiple stages of the audit cycle, from data collection to risk assessment and fraud detection. (Venkatasubramanian, 2023, pp. 328-343) The key applications are outlined below:

2.1. Data Extraction and Processing

AI driven auditing begins with the extraction and processing of large volumes of financial and non-financial data from diverse sources, including financial statements, transaction records, invoices, and receipts.

Advanced algorithms particularly those based on machine learning and Natural Language Processing (NLP) enable auditors to:

- Automate data collection from structured and unstructured sources
- Clean, classify, and standardize datasets
- Extract relevant audit evidence efficiently

NLP techniques are especially valuable in analyzing unstructured textual data such as contracts, emails, and reports, there, by improving the completeness and reliability of audit evidence in line with ISA 500 Audit Evidence.

2.2. Automated Data Analysis

The volume of data generated in financial environments presents a genuine challenge for auditors. Manual analysis of such data is slow, prone to error, and increasingly impractical given current transaction volumes. AI addresses this by automating substantial portions of the data analysis process. (Dell & Mfon , 2024, pp. 67-70) Here is how it does this:

- **Real time analysis:** AI operates without the time constraints that limit human auditors. It can process large datasets in real time, producing results that would otherwise require days or weeks of manual work.
- **Advanced algorithms:** Advanced algorithms enable AI to analyse financial data and detect errors, inconsistencies, and anomalies with greater consistency than humans. They also improve over time through continuous learning, enhancing their accuracy as more data is processed.
- **Error reduction:** Automated analysis reduces the effort spent on routine verification and validation tasks. It also limits the influence of human bias, which tends to affect judgment in ways that are difficult to detect or correct after the fact.
- **Efficiency and accuracy:** The practical result is an auditing process that is both faster and more reliable. When auditors can trust the underlying data, their conclusions carry more analytical weight. By automating data analysis, AI does not just augment the auditing process; it revolutionizes it, laying the foundation for an audit that is efficient, inherently more reliable, and accurate.

2.3. Fraud Detection and Prevention

AI plays a critical role in strengthening fraud detection mechanisms. Machine learning models are trained to recognize known fraud patterns and continuously adapt to emerging schemes. Their main functions include:

- **Predictive analytics:** AI predictive analytics use historical data, statistical methods, and machine learning to identify early warning signs of fraud. Instead of reacting after fraud occurs, it enables auditors to detect risks in advance and prevent potential financial and reputational damage.
- **Pattern recognition:** AI is highly effective at analysing large volumes of transactional data to identify normal behaviour patterns. Any deviation from these patterns is quickly flagged for further investigation, helping auditors focus on suspicious activities.
- **Learning from history:** AI systems continuously improve by learning from past fraud cases. As fraud techniques evolve, the models update their understanding of what is normal and what is suspicious, allowing them to detect even new and subtle fraud attempts.
- **Flagging deviations:** AI automatically highlights unusual transactions or anomalies that fall outside expected behaviour. This reduces the risk of overlooking critical issues and helps auditors prioritize areas that require professional judgment.
- **Proactive fraud prevention:** Beyond detection, AI supports prevention by identifying suspicious activity at an early stage. This allows auditors to intervene before losses increase, shifting the process from reactive investigation to preventive control.
- **Enhanced security protocols:** AI also contributes to strengthening data security by monitoring access controls and detecting abnormal system behaviour. This ensures the integrity of financial data, which is essential for maintaining reliable audit evidence and high quality audit outcomes.

By leveraging anomaly detection and pattern recognition, AI enhances auditor's ability to respond to fraud risks in accordance with ISA 240 The Auditors Responsibilities Relating to Fraud.

2.4. Risk assessment AI

systems significantly improve audit risk assessment by analysing historical financial data and identifying patterns indicative of potential misstatements. The following are some ways in which it can assist:

- **Dynamic risk analysis:** Financial risks are constantly evolving, and AI systems are designed to adapt to these changes. They continuously update risk profiles based on the

most recent data, ensuring that auditors work with up to date and relevant risk assessments for timely decision making.

- **Nuanced understanding of risks:** AI goes beyond simple detection by analysing relationships between multiple variables within financial data. This helps build a more comprehensive view of risk, allowing auditors to better understand its sources and potential impact on financial statements.
- **Targeted audit approach:** Based on AI generated insights, auditors can focus their efforts on higher risk areas. This improves the efficiency and effectiveness of audit procedures by ensuring that critical sections receive greater attention and deeper analysis.
- **Optimised resource allocation:** By identifying areas with elevated risk, AI helps auditors allocate time and resources more efficiently. This allows for a more concentrated and effective audit of significant risk areas rather than spreading efforts evenly.
- **Predictive risk modelling:** AI uses advanced algorithms to forecast potential risks before they occur. This forward looking approach enables auditors to anticipate issues, plan accordingly, and take preventive actions to safeguard financial reporting quality.
- **Interactive risk dashboards:** AI provides visual and interactive dashboards that present risk information clearly and intuitively. These tools help auditors explore risk patterns, assess scenarios, and support more informed audit planning and decision making.

  This supports a more robust implementation of ISA 315 Identifying and Assessing the Risks of Material Misstatement by enabling data driven and continuous risk assessment.

3. Benefits of AI in Auditing

Incorporating AI into the auditing process is not just a matter of staying current with technological advancements; it is also an essential strategy for enhancing the quality and effectiveness of audits. The implementation of AI in auditing brings forth a cascade of benefits that are transformative and far reaching. (Dell & Mfon , 2024, pp. 71-72) Let’s take a closer look at these:

3.1. Increased accuracy

- **Minimized human error:** AI doesn't get tired or distracted the way auditors do. It powers through massive amounts of data, catching details humans might miss, and that keeps audit results solid and trustworthy.
- **Precision in calculations:** When it comes to tough calculations, AI nails them every time. It delivers financial data and insights you can actually count on. That kind of precision matters it gives auditors and decision-makers the confidence they need for smart, well-grounded financial calls.

3.2. Efficiency

- **Swift data analysis:** AI speeds up data analysis. Instead of slogging through endless spreadsheets, auditors let AI handle the heavy lifting. It sorts through massive datasets fast what used to take days now happens in hours. The audit process moves quicker, and people spend less time buried in numbers.
- **Optimized workflow:** AI does more than just speed things up it actually makes the whole workflow smoother. You get easier integration and better coordination between different audit tasks, so everything moves from one stage to the next without those annoying delays or hang ups. The audit process flows, plain and simple.

3.3. Enhanced fraud detection

- **Proactive fraud identification:** AI doesn't just sit around hoping to catch fraud it hunts for it. Using predictive analytics and sharp pattern recognition, AI spots unusual transactions or trends. When something looks suspicious, it flags it right away for a closer look.
- **Historical data learning:** AI digs into historical data, picking up on usual transaction patterns and behaviours linked to a specific account or organization. Once it knows what's normal, it spots anything out of the ordinary those anomalies that flag possible fraud. This early detection gives auditors a heads up before issues get out of hand.

3.4. Improved risk assessment

- **Dynamic risk analysis:** With AI, it goes beyond scanning static data now, it weighs different variables and how they interact. This gives you a sharper, more layered view of the risks lurking in an organizations financial statements. Instead of a flat snapshot, you see a living, shifting map of potential trouble spots.
- **Targeted audit focus:** AI's risk analysis lets auditors zero in on the spots that matter most. Instead of spreading themselves thin, they dig into high risk areas and don't waste time on the parts that barely need attention. That way, the riskiest issues get the inspection they deserve.

These benefits collectively lead to audits that are faster, more accurate, and more analytical. The integration of AI into external auditing marks a shift from a purely compliance focused approach to one that emphasizes deeper analysis, interpretation, and support for financial decision making. With AI tools, auditors are better equipped to manage the complexity of modern financial environments and deliver more effective and value added audit services in a rapidly evolving business context.

Section 03: Ethical Challenges and Limitations of AI in External Auditing

The integration of artificial intelligence into external auditing offers significant benefits, but it also raises important ethical challenges and practical limitations. Issues such as transparency, accountability, data quality, and regulatory uncertainty may affect the reliability of AI assisted audits. Therefore, examining these challenges is essential to ensure alignment with professional and ethical standards.

1. Ethical Challenges of AI in External Auditing

The integration of artificial intelligence (AI) into auditing practices is reshaping external audit processes by enhancing data processing capabilities, risk detection, and decision support. However, the deployment of AI systems within audit environments introduces significant ethical challenges that stem from both the nature of AI technologies and the evolving structure of audit governance.

1.1. Governance gap and lack of standardization

External auditing of AI systems is constrained by the absence of unified standards and a stable regulatory framework comparable to those in financial auditing. As a result, audit practices vary significantly in scope, methods, and reporting. Ethical principles such as fairness, transparency, accountability, and privacy are widely recognized but remain difficult to operationalize in a consistent and measurable way. This challenge is intensified by the rapid evolution of AI technologies and regulatory uncertainty, which makes it difficult to establish stable benchmarks or evaluate audit quality in a standardized manner. (S, Kelley , & Camacho Ibáñez, 2024, pp. 01-11)

1.2.Transparency and Accountability Challenges in Data Access

A key challenge lies in the opacity of AI systems, especially complex machine learning models that function as black boxes. This limits auditor’s ability to fully understand system behaviour and weakens the reliability of audit assurance. At the same time, accountability is dispersed across multiple actors including developers, organizations, and auditors making it difficult to clearly assign responsibility in cases of error or harm. Auditors also face restricted access to data and model architectures due to privacy regulations and intellectual property constraints, which reduces the depth and effectiveness of audit procedures. (Jakob, 2023, pp. 04-18)

1.3. Ethical risks in practice and stakeholder imbalance

AI systems introduce significant ethical risks, particularly bias, discrimination, and unequal outcomes, which are often difficult to detect due to the complexity of sociotechnical environments. There is also a risk that AI ethics audits become symbolic exercises focused on reputation management rather than substantive risk mitigation ethics washing. Moreover, audit processes tend to prioritize technical experts and organizational leaders, while broader stakeholders such as users, vulnerable groups, and the public remain underrepresented, limiting the inclusiveness and legitimacy of audit outcomes. (Joakim, Minkkinen, & Mäntymäki, Matti, 2023, pp. 02-06)

2. Technical and Operational Limitations of AI in External Auditing

Despite the growing adoption of artificial intelligence in external auditing, its implementation is still constrained by several technical and operational limitations. These challenges can affect the reliability, efficiency, and integration of AI tools within audit processes, requiring careful consideration to ensure their effective use.

The effectiveness of AI in auditing is strongly constrained by issues related to data quality, availability, and governance. AI systems rely on complete, accurate, and consistent datasets, yet audit environments often involve incomplete, unstandardized, or biased data, which can distort outputs and weaken the reliability of audit evidence. In addition, auditors frequently face limited access to client data due to organizational control and fragmented information systems, reducing the efficiency of AI based procedures. These challenges are further reinforced by governance and regulatory requirements, particularly regarding data privacy, ownership, and compliance with frameworks such as the GDPR, which restrict how audit data can be collected and used. As a result, data related constraints remain a fundamental factor shaping the reliability and effectiveness of AI enabled auditing. (Sundarasen, Kamaludin, & Deepa , 2024, pp. 06-21)

2.1. Algorithmic Transparency and Explainability and Auditability Issues

Algorithmic transparency, explainability, and auditability represent central limitations of AI in auditing, particularly due to the increasing use of complex machine learning and deep learning models that operate as black box systems. These systems often generate highly accurate outputs, yet the underlying decision making processes remain difficult for auditors to interpret, document, and justify in accordance with audit standards such as ISA 500 and ISA 230. This lack of interpretability creates a gap between AI generated insights and the requirement for auditable evidence, as auditors may struggle to explain how conclusions were

derived or to validate the reliability of algorithmic outputs. As highlighted in the literature, this opacity not only weakens audit accountability but also raises regulatory concerns, since auditors remain ultimately responsible for the audit opinion despite relying on external or embedded AI systems. Although explainable AI approaches have been proposed to improve transparency, the practical integration of such solutions in auditing remains limited, leaving significant challenges in ensuring that AI assisted audit procedures are both understandable and defensible within professional and regulatory frameworks. (Leocádio, Malheiro, & Reis, 2024, pp. 03-06)

2.2. Integration, Cost, and Operational Implementation Challenges

The integration of AI into auditing is limited by significant operational and organizational constraints, including high implementation and maintenance costs, which reduce accessibility for smaller firms. Technical challenges also arise from difficulties in integrating AI systems with existing audit infrastructures and legacy processes. In addition, the adoption of AI requires new skills in data analytics and digital tools, creating a competency gap among auditors and increasing reliance on specialized expertise. Resistance to change, combined with regulatory uncertainty and the lack of standardized implementation frameworks, further slows down adoption. Consequently, despite its potential benefits, the operational deployment of AI in auditing remains uneven and highly dependent on organizational readiness and available resources. (Leocádio, Malheiro, & Reis, 2024, pp. 06-12)

3. Regulatory and Professional Constraints in AI Adoption

The adoption of AI in external auditing is limited by regulatory uncertainty, lack of standardized frameworks, and evolving technological complexity. These challenges also create professional constraints, particularly regarding auditor competence and independence, making it difficult to fully align AI based audits with ISA requirements and IFAC ethical principles. (Manheim, Martin, Bailey, Samin, & Greutzmacher, 2025, pp. 02-13)

3.1. Challenges of Fragmentation and Obsolescence in AI Audit Standards

From an ISA perspective, audit quality depends on consistent application of auditing standards ISA 200 and a stable understanding of the entity and its environment ISA 315. However, AI systems evolve continuously through model updates, retraining, and emergent capabilities, making audit benchmarks rapidly obsolete.

This volatility undermines the auditor’s ability to obtain reasonable assurance, as required by ISA 200, since audit criteria are not stable over time. Moreover, ISA 315 requires a reliable identification and assessment of risks of material misstatement; yet in AI

environments, risk profiles shift dynamically with system updates, rendering traditional static audit frameworks insufficient.

Consequently, the lack of standardized and stable AI audit frameworks limits the auditor's ability to apply risk based auditing effectively.

3.2. Regulatory Ambiguity and Professional Competency Gaps in AI Auditing

ISA 500 emphasizes that auditors must obtain sufficient appropriate audit evidence, while ISA 220 requires engagement partners to ensure adequate competence and capabilities of the audit team. In the context of AI, these requirements become difficult to satisfy due to the technical complexity of machine learning models and data driven systems.

Additionally, the IFAC Code of Ethics principles of professional competence and due care requires auditors to maintain up to date knowledge and skills. However, AI auditing demands advanced competencies in data science, algorithmic reasoning, and model evaluation areas not traditionally covered in external audit training.

This creates a professional capability gap, where auditors may lack the technical expertise to evaluate AI driven systems or properly interpret model outputs, thereby affecting audit evidence quality and reliability.

3.3. Governance Weaknesses and Threats to Independence in AI Audit Ecosystems

ISA 250 highlights the auditor's responsibility to consider laws and regulations, while IFAC's fundamental principles emphasize independence, objectivity, and professional scepticism.

However, AI audit ecosystems are often shaped by industry led frameworks, voluntary standards, and self-regulation mechanisms, which can compromise auditor independence. This raises risks of safety washing, where compliance is reported without substantive assurance.

Furthermore, reliance on internal audits or company controlled evaluation frameworks conflicts with the IFAC principle of independence in appearance and in fact. Without external governance mechanisms, audit credibility is weakened, and regulatory capture becomes a significant risk.

Therefore, strong, independent, multi stakeholder governance structures are necessary to preserve audit integrity and align AI auditing with ISA and IFAC requirements.

Conclusion

In conclusion, this chapter has provided a coherent and structured analysis of artificial intelligence and its progressive integration into external auditing. It first established the fundamental concepts of AI, then explored the main tools and applications that are transforming audit practices by enhancing efficiency, accuracy, and analytical depth. At the same time, it critically examined the ethical, technical, and regulatory challenges associated with this transformation, particularly those related to transparency, data quality, governance, and auditor competence.

Overall, while AI represents a major opportunity to improve audit quality and support more data driven and insightful audit approaches, its effective adoption remains conditional upon the establishment of appropriate regulatory frameworks, robust governance mechanisms, and the continuous development of auditors technical and professional capabilities.

Building on these theoretical and analytical foundations, the following chapter transitions to a practical perspective through a case study, where the results will be presented and critically discussed.

CHAPTER III:

Practical Study On The Impact Of Artificial Intelligence On External Auditing Practices In Major Algerian Companies

Introduction

This chapter represents the practical framework of the present research, which focuses on the integration of Artificial Intelligence (AI) technologies in the field of external auditing within the Algerian context. It aims to provide an empirical analysis of the current state of the auditing profession in Algeria and to evaluate the extent to which modern AI based technologies are being adopted and utilized by auditors and audit firms.

The chapter begins with an overview of the Algerian auditing environment, highlighting the evolution of the profession, the regulatory framework governing external auditing practices, and the challenges faced by auditors in a rapidly digitalized business environment. Attention is given to the growing importance of technological transformation and the need for audit firms to adapt to advanced digital tools to improve audit quality, efficiency, and reliability.

In addition, this chapter examines the practical implementation of several AI technologies in auditing activities, including Robotic Process Automation (RPA), Natural Language Processing (NLP), and Audit Data Analytics (ADA). These technologies are analyzed in relation to their impact on audit procedures, risk assessment, fraud detection, data analysis, decision making processes, and the overall effectiveness of external audits.

To achieve the objectives of this study, a quantitative research methodology was adopted through the distribution of questionnaires to professionals and individuals related to the auditing and accounting field in Algeria. The collected data were analyzed using statistical tools to test the research hypotheses and evaluate the relationship between AI adoption and audit performance.

Finally, this chapter presents and interprets the empirical findings obtained from the statistical analysis, providing a comprehensive discussion of the, the chapter ultimately seeks to assess the opportunities, challenges, and prospects of integrating AI technologies into external auditing practices in Algeria.

Section 01: Methodology and Data Processing Tools

This section presents the methodology adopted to conduct the empirical study, as well as the tools used for data collection and processing. It also explains the research approach, the sample selection, and the statistical techniques applied to analyse the collected data and test the research hypotheses.

1. Research Methodology

1.1. Choice of the Quantitative Methodological Approach

In management sciences, two main methodological approaches are generally distinguished: the quantitative and the qualitative approaches. Within a hypothetical deductive research design, the quantitative approach is often used or combined with other methods to verify whether the selected explanatory variables effectively confirm the relationships predicted by the previously developed theoretical model. (Tounès A. , 2003)

In this study, data collection is based on a quantitative approach. To the best of our knowledge, there is a lack of secondary data specifically addressing the impact of artificial intelligence on external auditing practices within major Algerian companies. Therefore, this research relies mainly on primary data collected directly in the field.

Data collection was carried out using a questionnaire survey administered to various stakeholders, including external auditors, internal auditors, financial auditors, audit managers, and accounting professionals.

The questionnaire was chosen as the main data collection instrument for this study. The diagram below summarizes the research approaches in management sciences according to the different modes of reasoning.

1.2. Study Variables

Our study includes two categories of variables:

1.2.1. Dependent variable (Y)

As its name suggests, this is the variable that we aim to explain. In the context of our study, the dependent variable refers to the effectiveness of external auditing practices in the context of artificial intelligence adoption. It is reflected through several dimensions, including:

- detecting anomalies and errors;
- risk assessment;
- automation of repetitive tasks;
- increased productivity and audit efficiency;

- analysis of financial statements and reports;
- provision of valuable insights during the audit process.

1.2.2. Independent variable (X)

This is the variable used to explain the dependent variable. In the context of our study, the independent variable is Artificial Intelligence in external auditing practices. It is operationalized through the following technologies:

- Data Analytics (DA);
- Robotic Process Automation (RPA);
- Natural Language Processing (NLP).

1.3. The Empirical Approach Process

The empirical part of this study follows a structured research design aimed at investigating the impact of artificial intelligence on external auditing practices in major Algerian companies. The methodological approach adopted is quantitative and is based on a questionnaire survey as the primary data collection instrument.

1.3.1. Presentation of the Survey

To complement and strengthen the theoretical framework of this study on the impact of artificial intelligence on external auditing practices, particularly through audit quality and related performance factors, it was considered appropriate to use a questionnaire as the main research instrument. The questionnaire is widely recognized as one of the most effective tools for empirical research, as it enables the systematic collection of quantitative and qualitative data.

Accordingly, the questionnaire was designed to gather relevant information necessary for the empirical analysis of the study. Its development was directly aligned with the research problem and the hypotheses previously established, drawing on the theoretical framework and a range of relevant academic sources related to artificial intelligence and auditing.

During the design phase, strict methodological principles were followed to ensure the reliability and validity of the instrument, including:

- Alignment of the questions with the research objectives and hypotheses;
- Ensuring the credibility and relevance of the questions;
- Clarity and accessibility of the wording;
- Precision in both questions and response options;
- Logical organization and overall coherence of the questionnaire.

The questionnaire included a variety of question types, primarily closed ended questions multiple choice, checkboxes, and matrix questions, this structure facilitated efficient data collection while allowing for deeper insights into participant's perspectives.

As a preliminary step, a pilot test was conducted with a limited sample of five respondents to assess the clarity, coherence, and comprehensibility of the questionnaire. Following this initial testing phase, the questionnaire was reviewed by several specialists in the field to evaluate its content and to incorporate suggestions for improvement, thereby minimizing potential technical or methodological errors.

1.3.2. Questionnaire Design

The design of the questionnaire represented a critical stage of the research methodology and was carried out with rigor and precision to ensure the collection of reliable and relevant data regarding the impact of artificial intelligence on external auditing practices. Following an iterative process of development, revision, and validation, the final version of the questionnaire was established. It consisted of 12 carefully selected questions structured to address the objectives of the study and test the proposed research hypotheses.

analysis. Overall, the instrument aimed to provide a comprehensive understanding of how artificial intelligence technologies are transforming external auditing practices, particularly in terms of efficiency, audit quality, and the evolution of auditor's competencies within the Algerian context

The questionnaire designed for this study consists of twelve (12) main questions organized into several thematic axes in order to examine the impact of artificial intelligence on external auditing practices.

The first axe: General Information about Respondents

This section includes six (06) questions related to the general characteristics of the respondents. It aims to identify the profile of the study sample through several variables such as:

- gender;
- age;
- educational level;
- professional position;
- years of experience;
- sector of activity.

The objective of this section is to better understand the demographic and professional characteristics of the respondents in order to interpret the study results more accurately.

The second axe: Knowledge and Use of Artificial Intelligence Tools

This section includes two (02) questions related to:

- the respondents level of knowledge regarding artificial intelligence tools applied in auditing;
- the AI tools currently used in professional audit practices.

The technologies examined in this questionnaire mainly include:

- Audit Data Analytics (ADA);
- Robotic Process Automation (RPA);
- Natural Language Processing (NLP).

The objective of this section is to measure the degree of adoption of artificial intelligence technologies in external auditing practices.

The third axe: Audit Data Analytics (ADA)

This section contains one question composed of four (04) Likert scale statements related to the use of Audit Data Analytics in audit engagements.

The statements aim to evaluate the impact of ADA on:

- the efficiency of audit tasks;
- the detection of anomalies and errors;
- risk assessment procedures;
- reducing the time required for audit procedures.

The objective of this section is to analyse auditor's perceptions regarding the effectiveness of data analytics techniques in improving the quality of external audit engagements.

The fourth axe: Robotic Process Automation (RPA)

This section includes one question composed of four (04) Likert scale statements focusing on the use of Robotic Process Automation in auditing practices.

The statements mainly concern:

- the automation of repetitive audit tasks;
- improving the speed of audit procedures;
- enabling auditors to focus on higher value analytical tasks;
- the development of new technical competencies.

The objective of this section is to evaluate the impact of RPA on audit efficiency and on the evolution of the external auditor's role.

The fifth axe: Natural Language Processing (NLP)

This section contains one question composed of four (04) Likert scale statements related to the use of Natural Language Processing in auditing activities.

The statements mainly focus on:

- analyzing financial and textual documents;
- improving the quality of audit evidence;
- supporting auditors' decision-making processes;
- reducing human errors in document analysis.

The sixth axe: Overall Impact of Artificial Intelligence on External Auditing

This section contains one question composed of five (05) statements formulated using the Likert scale. It aims to evaluate professional's perceptions regarding the overall impact of artificial intelligence tools on external audit engagements.

The statements mainly address:

- the improvement of audit quality;
- the reliability of audit evidence;
- the detection of errors, fraud, and anomalies;
- the effectiveness of audit procedures;
- time savings in performing audit tasks.

The objective of this section is to measure auditor's perceptions regarding the contribution of artificial intelligence technologies to improving external audit performance.

The Likert scale, also known as an attitude scale, is a measurement tool commonly used in surveys to assess respondent's perceptions, attitudes, and opinions.

To enhance the quality and depth of the collected data, different question formats were employed, including multiple choice questions, checkbox questions, and matrix based questions. In addition, conditional logic was integrated into the questionnaire to adapt the sequence of questions according to respondent's answers, thereby improving relevance and response accuracy.

The questionnaire was developed using Google forms, which offered flexibility in design, ease of distribution, and efficient organization of responses for subsequent statistical analysis. Overall, the instrument aimed to provide a comprehensive understanding of how artificial intelligence technologies are transforming external auditing practices, particularly in terms of efficiency, audit quality, and the evolution of auditor's competencies within the Algerian context

1.4. Study Sample

To enhance this process, we conduct the empirical component of this research, data were collected through the distribution of the questionnaire to a targeted sample of professionals involved in auditing and accounting practices. The objective was to obtain diverse and relevant insights reflecting real world practices related to the use of artificial intelligence in auditing.

1.4.1. Scope and Delimitation of the Study

- **Objectivity of the Study**

The research primarily focuses on examining the perceived impact of advanced artificial intelligence technologies particularly Robotic Process Automation (RPA), Audit Data Analytics (ADA), and Natural Language Processing (NLP) on external auditing practices. Special attention is given to their influence on the overall quality and effectiveness of audits, the reliability of audit evidence, the detection of errors, fraud, and anomalies, as well as the efficiency and speed of audit procedures. This approach enables a comprehensive and objective evaluation of how AI based tools contribute to improving audit performance and enhancing the effectiveness of external auditing processes.

1.4.2. Sample Size and Response Rate

A total of 135 questionnaires were distributed to potential respondents. Out of these, 60 valid responses were collected and retained for analysis, resulting in a response rate of approximately 44.4%, which is considered acceptable for empirical research in the fields of accounting and auditing.

2. Pre-test of the Questionnaire

The validity of the questionnaire is closely linked to the reliability of the measurement scales. Reliability refers to the extent to which the items of a scale consistently measure the same underlying concept.

***Table 3** : Interpretation of Cronbach's Alpha*

Cronbach's Alpha (α) Value	Interpretation
α < 0.6	Unacceptable
α > 0.6	Acceptable for exploratory research
α > 0.8	Good / acceptable for confirmatory research
α = 1	Perfect reliability (complete collinearity)

Source: Prepared by the Student

3. Questionnaire Distribution Planning

The distribution of the questionnaire represented a carefully planned and essential stage of the research methodology. Before to the actual distribution process, significant attention was given to designing an effective distribution strategy aligned with the objectives of the study. The primary aim was to collect reliable and relevant data regarding the impact of artificial intelligence technologies particularly Robotic Process Automation (RPA), Audit Data Analytics (ADA), and Natural Language Processing (NLP) on external auditing practices.

First, the objectives of the survey were clearly defined by identifying the key dimensions to be explored, including audit quality, efficiency, reliability of audit evidence, fraud detection, and the evolving role of auditors in an AI driven environment. This step ensured that the questionnaire targeted the most relevant information required to address the research problem and test the study hypotheses.

Next, particular attention was devoted to identifying and analyzing the target population, which consisted mainly of external auditors, internal auditors, financial auditors, audit managers, and accountants working in audit firms and multinational companies. Understanding the professional characteristics of these respondents helped in selecting the most appropriate communication and distribution methods to maximize participation and improve the representativeness of the collected data.

Based on this analysis, a comprehensive distribution strategy was adopted using primarily online channels, such as Google Forms, professional networks, email communication, and social media platforms commonly used by accounting and auditing professionals. This approach facilitated access to a broader range of respondents from different professional environments and increased the efficiency of the data collection process.

Therefore, the planning and implementation of the questionnaire distribution process were conducted in a rigorous and organized manner, ensuring the collection of high quality and representative data suitable for empirical analysis in the field of auditing and artificial intelligence.

3.1. Distribution Methods

After conducting a thorough analysis of the target population, an appropriate distribution strategy was developed by carefully selecting communication channels adapted to the objectives of the study and the professional profile of respondents. A multichannel approach was adopted to reach a broad range of professionals involved in auditing and accounting activities.

The questionnaire was primarily distributed online using Google Forms, which served as the main platform for data collection. The questionnaire link was shared through various professional and social media networks, targeting external auditors, internal auditors, financial auditors, audit managers, and accountants. This online distribution approach facilitated access to respondents from different professional environments and allowed for efficient and rapid data collection.

In addition to online distribution, a direct distribution approach was also adopted to increase participation and improve the diversity of responses. Questionnaires were shared with professionals working in audit firms and multinational companies, enabling respondents to participate in a more direct and practical manner. This combined approach contributed to increasing the response rate and ensuring a broader representation of professionals involved in external auditing practices.

The use of both online and direct distribution methods provided a more comprehensive perspective on the research topic and strengthened the reliability and representativeness of the collected data regarding the impact of artificial intelligence technologies on external auditing practices within the Algerian context.

3.2. Distribution Results

To maximize the reach of the survey, a diversified distribution approach was adopted, combining direct distribution with modern online methods such as social media sharing and email dissemination. This strategy enabled access to a wide range of respondents from different professional backgrounds and regions.

Responses were collected both in person and through Google Forms, where participation trends were continuously monitored to ensure data quality and completeness.

A total of 135 questionnaires were distributed, of which 60 valid and complete responses were retained for analysis after excluding incomplete or unusable responses. This corresponds to a response rate of approximately 44.4%, which is considered acceptable for empirical research in auditing and accounting studies. The final sample provides a reliable basis for the subsequent statistical analysis and interpretation of results.

The final collected responses provide a solid basis for the empirical analysis of the study. The detailed distribution results are summarized in the table below, offering a clear overview of the data collection process and response outcomes.

***Table4**: Distribution of Questionnaires*

Distribution method	Distributed	Not received	Received	Rejected	Valid for analysis
Online (Google Forms)	100	25	75	25	50
Direct distribution	35	20	15	5	10
Total	135	45	90	30	60
Percentage	100%	33.3%	66.6%	22.2%	44.4%

Source: Prepared by the Student

The final sample retained for analysis consists of 60 valid questionnaires out of 135 distributed, corresponding to a response rate of 44.4%. This level of participation is considered acceptable for empirical research in accounting and auditing. The collected data thus constitute a reliable foundation for the subsequent statistical analysis and interpretation of results within the framework of this study.

4. Data Processing Tools

To achieve the objectives of this research, the collected data were systematically processed and analyzed using appropriate statistical techniques. For this purpose, the Statistical Package for the Social Sciences (SPSS), version 23, was employed to facilitate data analysis and interpretation.

SPSS is a widely used statistical software in social sciences and management research, offering a comprehensive set of tools for quantitative data analysis. Its use in this study allowed for efficient data management, statistical testing, and result interpretation.

The software enabled the application of various analytical procedures, including descriptive statistics, correlation analysis, and reliability testing, thereby ensuring a structured and rigorous examination of the collected data.

Additionally, SPSS facilitated the generation of tables and graphical representations, which helped in visualizing data patterns, trends, and relationships between variables. This contributed to clearer interpretation and more effective presentation of results.

Overall, SPSS proved to be an essential tool in ensuring the accuracy, reliability, and scientific rigor of the data analysis process.

4.1. Statistical Methods Used

Several statistical methods were employed in this study to analyse the collected data and test the research hypotheses:

- **Percentages and Descriptive Statistics**

  These methods were used to summarize and describe the distribution of responses across different variables. They allowed for a clear understanding of respondent's perceptions regarding the impact of artificial intelligence on auditing practices.

- **Principal Component Analysis (PCA)**

  Principal Component Analysis (PCA) is a multivariate statistical technique used to reduce data dimensionality while preserving as much information as possible. In this study, PCA was used to identify underlying patterns and relationships among variables related to artificial intelligence in auditing.

  PCA transforms correlated variables into a smaller number of uncorrelated components, known as principal components, which explain the maximum variance in the dataset. This method is particularly useful for simplifying complex datasets and highlighting the most significant factors influencing audit performance.

  In the context of this research, PCA helped identify the key dimensions underlying the impact of artificial intelligence technologies such as Automated Data Analytics (ADA), Robotic Process Automation (RPA), Natural Language Processing (NLP), on audit efficiency, risk assessment, anomaly detection, and audit quality.

Section 02: Data Processing and Analysis Using Statistical Methods

This section presents the statistical methods used to process and analyse the collected data. It explains the techniques applied to interpret the results, examine the relationships between variables, and test the research hypotheses.

1. Data Quantification

In this section, we provide a detailed description of the data quantification process adopted in this study. This process involves transforming qualitative responses into numerical values to facilitate statistical analysis. The methods used for assigning numerical scores to the studied variables, as well as the measurement scales and classification criteria, are clearly defined. This step is essential, as it ensures the reliability of subsequent statistical analyses and supports the formulation of meaningful and evidence based conclusions.

1.1. Descriptive data statistics

1.1.1. First axis demographic and professional data

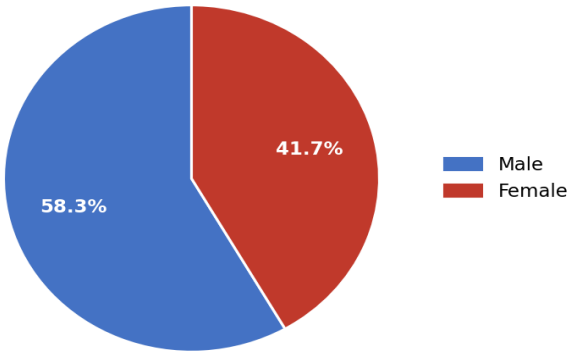
For questions relating to participants demographic and professional profile, responses were coded as categorical variables and assigned numerical values for processing purposes, as illustrated in the tables below:

***Table5** : Gender Distribution*

Category	Frequency	Percent (%)	Cumulative Percent (%)
Male	35	58.3%	58.3%
Female	25	41.7%	100%
Total	**60**	**100%**	

Source: Primary data processed using SPSS software.

***Figure 1** : Gender distribution of survey respondents*



Source: prepared by the student based on questionnaire data

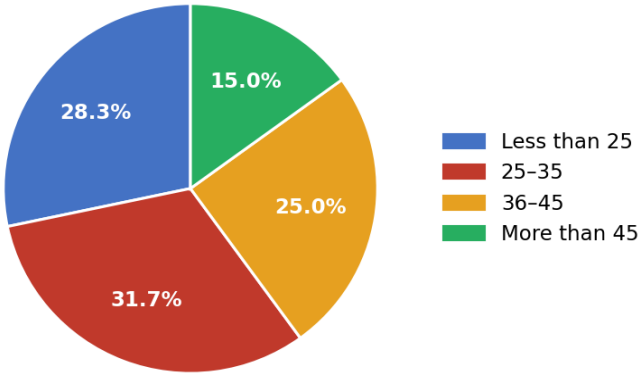
The table above presents the gender distribution of the 60 respondents included in the study. The majority of respondents are male, representing 58.3% (n = 35) of the total sample, while female respondents account for 41.7% (n = 25). This indicates that male professionals are more predominant in the surveyed population, though both genders are reasonably represented, lending a degree of diversity to the sample. The imbalance may reflect the demographic composition of the auditing and accounting profession in the study context.

***Table6** : Age Distribution*

Category	Frequency	Percent (%)	Cumulative Percent (%)
Less than 25	17	28.3%	28.3%
25 – 35	19	31.7%	60%
36 – 45	15	25%	85%
More than 45	9	15%	100%
Total	**60**	**100%**	

Source: Primary data processed using SPSS software.

***Figure 2** : Educational level distribution of survey respondents*



Source: prepared by the student based on questionnaire data

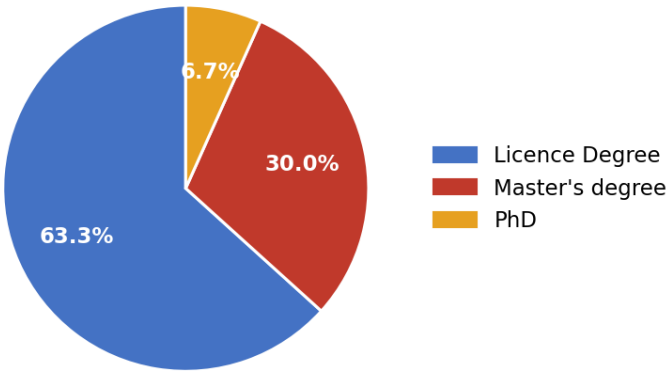
The age distribution of respondents reveals a relatively young and midcareer sample. The most represented age group is 25–35 years (31.7%, n = 19), followed closely by respondents under 25 years (28.3%, n = 17). Together, these two groups account for 60.0% of the sample, indicating that the majority of participants are in the early to mid-stages of their professional careers. Respondents aged 36–45 represent 25.0% (n = 15), while those over 45 years are the smallest group at 15.0% (n = 9). This distribution suggests that the study captures perspectives primarily from younger professionals, which may influence attitudes towards emerging technologies such as AI based audit tools.

***Table7** : Education Levels*

Category	Frequency	Percent (%)	Cumulative Percent (%)
License Degree	4	6.7%	6.7%
Master's Degree	38	63.3%	70%
PhD	18	30%	100%
Total	**60**	**100%**	

Source: Primary data processed using SPSS software

***Figure 3**: Educational level distribution of survey respondents*



Source: prepared by the student based on questionnaire data

The education level data shows that the sample is highly educated. The dominant qualification is a Master's degree, held by 63.3% of respondents (n = 38), indicating a high level of academic preparation among the participants. PhD holders constitute the second largest group at 30.0% (n = 18), further underlining the advanced academic profile of the sample. Only 6.7% (n = 4) hold a License degree. The predominance of postgraduate qualifications suggests that respondents are well positioned to critically evaluate the use of AI based tools in auditing, lending credibility and reliability to the study's findings.

***Table8** : Professional Role*

Category	Frequency	Percent (%)	Cumulative Percent (%)
External Auditor	19	31.7%	31.7%
Internal Auditor	10	16.7%	48.3%
Financial Auditor	11	18.3%	66.7%
Audit Manager	16	26.7%	93.3%
Accountant	4	6.7%	100%
Total	**60**	**100%**	

Source: Primary data processed using SPSS software

The distribution of respondents by professional role shows a diverse mix of audit and accounting practitioners. External Auditors form the largest group at 31.7% (n = 19), followed by Audit Managers at 26.7% (n = 16), and Financial Auditors at 18.3% (n = 11). Internal Auditors represent 16.7% (n = 10), while Accountants account for the smallest group at 6.7% (n = 4). The high representation of external auditors and audit managers is particularly relevant

given the study's focus on the impact of AI tools on external audit quality. The variety of professional roles within the sample enhances the breadth and representativeness of the data.

***Table9** : Years of Professional Experience*

Category	Frequency	Percent (%)	Cumulative Percent (%)
Less than 2 years	11	18.3%	18.3%
2 – 5 years	20	33.3%	51.7%
5 – 10 years	19	31.7%	83.3%
More than 10 years	10	16.7%	100%
Total	**60**	**100%**	

Source: Primary data processed using SPSS software.

Concerning professional experience, a large proportion of respondents fall within the 2–5 years range (33.3%, n = 20), closely followed by those with 5–10 years of experience (31.7%, n = 19). Together, these two categories represent 65.0% of the total sample, indicating that the majority of participants possess a solid professional background in the auditing field. Respondents with less than 2 years of experience represent 18.3% (n = 11), whereas those with more than 10 years of experience account for 16.7% (n = 10). This distribution across different experience levels allows the study to reflect the perspectives of both junior professionals and experienced practitioners, thereby enhancing the reliability and comprehensiveness of the findings.

***Table10** : Industry Sector*

Category	Frequency	Percent (%)	Cumulative Percent (%)
Audit Firm	19	31.7%	41.3%
Multinational	27	45%	100%
Total (Valid)	**46**	**76.7%**	
Missing (System)	*14*	*23.3%*	
Total	**60**	**100%**	

Source: Primary data processed using SPSS software.

The industry sector variable contains 14 system missing values, meaning only 46 of the 60 respondents provided a response to this item. Among valid responses, the majority work in multinational companies (58.7%, n = 27), while 41.3% (n = 19) are employed in audit firms. The high proportion of respondents from multinational organizations may reflect greater exposure to AI based tools, given the resource capacity and technological investment typically

associated with large multinationals. The missing data (23.3%) should be noted as a limitation, as it may affect the generalizability of findings related to sector specific differences.

1.1.2. The Second Axis: AI Knowledge Level and the Use of AI-Based Tools in External Auditing

This section aims to assess the respondents level of knowledge regarding Artificial Intelligence (AI) tools in the field of external auditing, as well as the extent to which these technologies are used in professional practices. It focuses particularly on the use of major AI based tools, namely Advanced Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP). The purpose of this axis is to provide an overview of participant's familiarity with AI technologies and their practical integration into auditing activities.

***Table11**: AI Knowledge Level and Tool Usage Among Respondents*

AI Knowledge Level and Too]=	Frequency	Percent (%)	Cumulative Percent (%)
Knowledge Level Regarding AI Tools in Auditing			
Low	1	1.7%	1.7%
Medium	19	31.7%	33.3%
Good	32	53.3%	86.7%
Advanced	8	13.3%	100%
Total	**60**	**100%**	—
Use of Advanced Data Analytics (ADA) Tool			
No	36	60%	60%
Yes	24	40%	100%
Total	**60**	**100**%	—
Use of Robotic Process Automation (RPA) Tool			
No	35	58.3%	58.3%
Yes	25	41.7%	100%
Total	**60**	**100%**	—
Use of Natural Language Processing (NLP) Tool			
No	48	80%	80%
Yes	12	20%	100%
Total	**60**	**100%**	—

Source: Primary data processed using SPSS software

Regarding the level of knowledge, most respondents demonstrated a solid familiarity with AI tools in auditing. More than half (53.3%) reported a good level of knowledge, followed by 31.7% at a medium level, and 13.3% at an advanced level. Only 1.7% reported a low level of knowledge. This indicates that the sample is composed predominantly of individuals with sufficient understanding of AI in an audit context, lending credibility to their perceptions reported in the previous section.

In terms of tool usage, Advanced Data Analytics (ADA) and Robotic Process Automation (RPA) showed comparable adoption rates, with 40% and 41.7% of respondents reporting use of each tool respectively. This suggests a moderate but meaningful integration of these technologies within audit practice among the sampled professionals.

Natural Language Processing (NLP), however, recorded the lowest adoption rate, with only 20% of respondents indicating its use. This is consistent with the broader literature, as NLP remains a more specialized and technically demanding tool compared to ADA and RPA, and its application in auditing is still at a relatively early stage.

Overall, these findings suggest that while AI awareness is high among respondents, actual tool adoption, particularly for more advanced technologies such as NLP remains limited, pointing to a gap between knowledge and practice that may warrant further investigation in the thesis.

4.1.1. The Third Axis: Audit Data Analytics (ADA)

This section examines the contribution of Audit Data Analytics (ADA) to the improvement of external auditing practices. It aims to evaluate respondent's perceptions regarding the role of ADA in enhancing audit efficiency, detecting anomalies, improving risk assessment, and reducing the time required to perform audit procedures. The questionnaire items were measured using a five point Likert scale ranging from Strongly Agree to Strongly Disagree.

***Table12** : Likert Scale Degrees for Perception Items*

Response	Degree
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

Source: Prepared by the student

***Table13** : Perceptions of Advanced Data Analytics (ADA) in Auditing*

Statement	Minimum	Maximum	Mean	Standard Deviation
The use of ADA improves the efficiency of audit tasks.	2	5	4.26	0.81
ADA enhances the detection of anomalies and errors in financial data.	2	5	4.17	0.78
ADA contributes to more effective risk assessment.	2	5	3.87	0.87
ADA reduces the time required to perform audit procedures.	2	5	3.87	1.06

Source: Primary data processed using SPSS software

The descriptive statistics show that respondents generally have positive perceptions regarding the use of Audit Data Analytics (ADA) in external auditing. The highest mean was recorded for the statement "The use of ADA improves the efficiency of audit tasks" (Mean = 4.26; SD = 0.81), indicating strong agreement that ADA enhances audit efficiency.

Respondents also agreed that ADA improves the detection of anomalies and errors in financial data (Mean = 4.17; SD = 0.78). In addition, participants considered that ADA contributes to more effective risk assessment and reduces the time required to perform audit procedures (Mean = 3.87).

Overall, the results suggest that ADA positively contributes to improving audit effectiveness, particularly in anomaly detection, risk assessment, and audit efficiency.

1.1.4. The Fourth Axis: Robotic Process Automation (RPA)

This section examines the role of Robotic Process Automation (RPA) in improving external auditing practices. It aims to assess respondent's perceptions regarding the contribution of RPA to automating repetitive audit tasks, improving the efficiency and speed of audit procedures, and allowing auditors to focus on higher value analytical activities. The questionnaire items were measured using a five point Likert scale ranging from Strongly Agree to Strongly Disagree.

***Table14** : Perceptions of Robotic Process Automation (RPA) in Auditing*

Statement	Minimum	Maximum	Mean	Standard Deviation
RPA automates repetitive tasks in the auditing process.	2	5	4.36	1.04
RPA improves the efficiency and speed of audit procedures.	1	5	3.92	1.00
RPA allows auditors to focus on higher-value analytical tasks.	2	5	4.04	1.14
The use of RPA requires auditors to develop new technical competencies.	1	5	3.68	1.03

Source: Primary data processed using SPSS software

The descriptive statistics indicate that respondents generally hold positive perceptions regarding the use of Robotic Process Automation (RPA) in external auditing. The highest mean was recorded for the statement "RPA automates repetitive tasks in the auditing process" (Mean = 4.36; SD = 1.04), showing strong agreement that RPA contributes significantly to task automation.

Respondents also agreed that RPA improves the efficiency and speed of audit procedures (Mean = 3.92; SD = 1.00) and enables auditors to focus on higher-value analytical tasks (Mean = 4.04; SD = 1.14). In addition, participants acknowledged that the adoption of RPA requires auditors to develop new technical competencies (Mean = 3.68; SD = 1.03).

Overall, the results suggest that RPA positively contributes to improving audit efficiency and transforming auditors' professional roles.

1.1.5. The Fifth Axis: Natural Language Processing (NLP)

This section examines the role of Natural Language Processing (NLP) in enhancing external auditing practices. It aims to evaluate respondent's perceptions regarding the contribution of NLP to the analysis of financial and textual audit documents, the improvement of audit evidence quality, the support of audit decision making, and the reduction of human errors in document analysis. The questionnaire items were measured using a five point Likert scale ranging from Strongly Agree to Strongly Disagree.

***Table15** : Perceptions of Natural Language Processing (NLP) in Auditing*

Statement	Minimum	Maximum	Mean	Standard Deviation
NLP improves the analysis of financial and textual audit documents.	2	5	3.75	1.14
NLP enhances the quality of audit evidence.	2	5	3.50	1.31
NLP provides valuable insights for audit decision-making.	2	5	3.42	1.24
NLP reduces human errors in document analysis.	2	4	3.25	0.87

Source: Primary data processed using SPSS software.

The descriptive statistics show that respondents generally have positive perceptions regarding the use of NLP in external auditing. The highest mean was recorded for the statement "NLP improves the analysis of financial and textual audit documents" (Mean = 3.75; SD = 1.14), indicating that respondents believe NLP facilitates document analysis and information processing.

Respondents also agreed that NLP enhances the quality of audit evidence (Mean = 3.50; SD = 1.31) and supports audit decision-making (Mean = 3.42; SD = 1.24). The lowest mean concerned the reduction of human errors in document analysis (Mean = 3.25; SD = 0.87), showing a more moderate level of agreement.

Overall, the results suggest that NLP positively contributes to improving the quality and effectiveness of external auditing practices.

1.1.6. The sixth Axis: The Impact of the Integration of AI Tools on External Auditing Practices

This section examines and evaluates the contribution of AI based tools to the improvement of external auditing practices through several dimensions, namely the overall impact of AI on auditing, Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP). To measure participant's perceptions regarding these technologies, the questionnaire items were assessed using a five point Likert scale. Degree (5) was assigned to the most positive response (Strongly Agree), while degree (1) corresponded to the most negative response (Strongly Disagree).

***Table16** : Perceptions of AI Tools in External Auditing*

Statement	Minimum	Maximum	Mean	Standard Deviation
The use of AI-based tools improves the overall quality of external audits.	2	5	4.03	0.99
AI tools enhance the reliability of audit evidence obtained during the audit process.	1	5	3.93	0.99
AI technologies improve the auditor's ability to detect errors, fraud, and anomalies.	2	5	3.87	1.07
The use of AI tools increases the efficiency of audit procedures.	2	5	3.93	0.90
AI tools enable auditors to save time and complete audit engagements more quickly.	2	5	3.82	0.91

Source: Primary data processed using SPSS software

The descriptive statistics indicate that respondents generally have positive perceptions regarding the use of Artificial Intelligence in external auditing. The highest mean was recorded for the statement "The use of AI based tools improves the overall quality of external audits" (Mean = 4.03; SD = 0.99), showing strong agreement that AI contributes to audit quality improvement.

Respondents also agreed that AI tools enhance the reliability of audit evidence (Mean = 3.93; SD = 0.99) and increase the efficiency of audit procedures (Mean = 3.93; SD = 0.90). In addition, participants considered that AI technologies improve the detection of errors, fraud, and anomalies (Mean = 3.87; SD = 1.07) and help auditors save time during audit engagements (Mean = 3.82; SD = 0.91).

Overall, the results suggest that Artificial Intelligence positively contributes to improving the effectiveness, efficiency, and quality of external auditing practices.

2. Questionnaire Reliability: Cronbach's Alpha Coefficient

Before to data analysis, a critical preliminary step was undertaken to assess the internal consistency and reliability of the questionnaire. This evaluation was conducted using Cronbach's Alpha coefficient, a widely used statistical measure in management science research

that determines whether a set of items consistently measures the same underlying construct. A separate Cronbach's Alpha test was conducted for each of the four scales using SPSS version 23

***Table17** : Summary of Cronbach's Alpha Coefficients by Scale*

Scale	N° of Items	Valid Cases	Cronbach's Alpha	Interpretation
AUDIT	5	60	**0.806**	Good
ADA	4	23	**0.863**	Good
RPA	4	25	**0.936**	Excellent
NLP	4	12	**0.964**	Excellent

Source: Prepared by the students, based on SPSS software

According to established methodological standards, a Cronbach's Alpha coefficient is generally considered acceptable from 0.5, satisfactory from 0.6, good above 0.7, and excellent above 0.9. All four scales surpass the 0.8 threshold, confirming the internal consistency and reliability of the measurement instruments, and validating our decision to proceed with correlation and regression analyses.

Section 03: discussion results

After presenting the results of the descriptive statistics, a more in depth analysis is required.

We will first conduct several statistical tests, starting with the contingency coefficient (C coefficient), followed by the regression analysis to model the relationship between artificial intelligence and the effectiveness of external auditing practices in major Algerian companies. Finally, we will synthesize and interpret the results of our analysis.

SPSS software was used to perform all the statistical tests throughout this section.

1. Pearson's Contingency Coefficient (C)

Pearson's contingency coefficient (C) is used to measure the degree of association or co-occurrence between two qualitative variables. It provides an approximate and conservative estimate of the strength of the relationship between variables.

Since the dependent and independent variables in this study are qualitative in nature, this test was selected to measure the association between artificial intelligence adoption and the effectiveness of external auditing practices in major Algerian companies.

In this context, two hypotheses were formulated to test the contingency between the study variables:

The null hypothesis (H0) assumes that the relationship between artificial intelligence and external auditing practices is due to chance, meaning that no statistically significant relationship exists between the two variables.

The alternative hypothesis (H1) assumes that the relationship is not due to chance, indicating the existence of a statistically significant association between artificial intelligence and external auditing practices.

- $H0 : C = 0$
- $H1 : C \neq 0$

The value of Pearson's contingency coefficient (C) ranges between 0 and 1, and its interpretation is as follows:

- $C = 1$: Perfect relationship between X and Y
- $C > 0.8$: Very strong Relationship
- $0.5 < C < 0.8$: Strong Relationship
- $0.2 < C < 0.5$: Moderate Relationship
- $0 < C < 0.2$: Weak Relationship

- C = 0: No relationship (X and Y are independent)

The significance level (maximum risk of error) adopted in this study is 0.05.

- If the approximate significance (p-value) is greater than 0.05, H0 is accepted, indicating that any observed relationship is due to chance.
- If the p-value is less than 0.05, H0 is rejected and H1 is accepted, confirming the existence of a statistically significant relationship between artificial intelligence and external auditing practices.

1.1.The correlation between AI and EAP

To verify the correlation between artificial intelligence and external auditing, it is necessary to examine the relationships between the different components of both variables, i.e., the associations between their respective dimensions

***Table18** : Pearson Correlation Matrix*

	Audit	ADA	RPA	NLP
Audit	**1** N = 60 N = 60	**.637**** p = .001 N = 23	**.709**** p = .000 N = 25	**.927**** p = .000 N = 12
ADA	**.637**** p = .001 N = 23	**1** N = 23 N = 23	— No overlap	— No overlap
RPA	**.709**** p = .000 N = 25	— No overlap	**1** N = 25 N = 25	— No overlap
NLP	**.927**** p = .000 N = 12	— No overlap	— No overlap	**1** N = 12 N = 12

Source: Prepared by the student, based on SPSS software

The following table presents the Pearson correlation results between external auditing practices (Audit) and the different artificial intelligence technologies used in this study, namely Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP).

The results show that external auditing practices are significantly and positively correlated with all AI technologies considered in the study.

A moderate positive correlation is observed between Audit and ADA (r = 0.637, p = 0.001), indicating that the use of audit data analytics is associated with improvements in external auditing practices.

A strong positive correlation is found between Audit and RPA (r = 0.709, p = 0.000), suggesting that robotic process automation contributes significantly to enhancing audit processes through automation and efficiency gains.

Finally, a very strong positive correlation is observed between Audit and NLP (r = 0.927, p = 0.000), which indicates that natural language processing plays a major role in improving the effectiveness of external auditing practices, particularly in the analysis of audit reports and unstructured data.

Overall, the results confirm that all three artificial intelligence technologies (ADA, RPA, and NLP) are positively and significantly associated with the effectiveness of external auditing practices in major Algerian companies.

2. Linear Regression Analysis

In order to examine the impact of Artificial Intelligence dimensions on external auditing, simple and multiple linear regression analyses were conducted using SPSS software. The analysis focused on three AI dimensions: Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP). Each dimension was first tested separately using simple regression analysis, followed by a multiple regression model integrating all AI dimensions simultaneously.

2.1. Simple Linear Regression Analysis

2.1.1. ADA Model Summary

***Table19** : ADA Model*

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
ADA	0.637	0.406	0.378	0.477

Source: Prepared by the student, based on SPSS software

The ADA model explains a moderate proportion of variance in audit effectiveness (R^2 = 0.406), meaning that 40.6% of changes in audit effectiveness are explained by ADA integration. This indicates a significant and meaningful impact of ADA on improving audit performance, particularly in risk assessment and anomaly detection.

2.1.2. Testing how ADA strengthens audit effectiveness of external auditing

Hypothesis 01: The integration of ADA significantly improves anomaly detection and risk assessment in auditing.

***Table20** : Variance ANOVA ADA*

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	3.261	1	3.261	14.331	0.001
Residual	4.778	21	0.228		
Total	8.038	22			

Source: Prepared by the student, based on SPSS software

The regression model shows a statistically significant relationship between ADA and audit effectiveness ($F = 14.331$, $p = 0.001$). This indicates that ADA has a significant positive effect on improving anomaly detection and risk assessment.

The model confirms that increasing the use of ADA enhances auditor's ability to identify risks and irregularities, thereby improving audit effectiveness. Therefore, the first hypothesis is validated.

2.1.3. RPA Model Summary

***Table21* :** *RPA Model*

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
RPA	0.709	0.503	0.481	0.532

Source: Prepared by the student, based on SPSS software

The RPA model shows a relatively strong explanatory power ($R^2 = 0.503$), indicating that RPA explains 50.3% of the variance in audit efficiency. This confirms that RPA significantly enhances audit productivity through automation and task optimization.

2.1.4. Testing how RPA enhances the efficiency of external auditing

Hypothesis 02: The integration of RPA significantly enhances productivity of audit tasks.

***Table22* :** *Variance ANOVA Table RPA*

Source	Sum of Squares	Df	Mean Square	F	Sig.
Regression	6.580	1	6.580	23.233	0.000
Residual	6.514	23	0.283		
Total	13.094	24			

Source: Prepared by the student, based on SPSS software

The regression results indicate a significant positive effect of RPA on audit efficiency ($F = 23.233$, $p < 0.001$). This confirms that RPA significantly enhances productivity in audit tasks.

RPA contributes by automating repetitive processes, reducing manual workload, and increasing audit speed, which directly improves operational efficiency. The second hypothesis is accepted.

2.1.5. NLP Model Summary

***Table23* :** *NLP Model*

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
NLP	0.927	0.860	0.846	0.362

Source: Prepared by the student, based on SPSS software

The NLP model demonstrates a very strong explanatory power ($R^2 = 0.860$), meaning that 86% of the variance in audit quality is explained by NLP integration. This highlights that NLP has the most powerful impact among the three technologies, significantly improving audit evidence quality, document analysis, and decision making accuracy.

2.1.6. Testing how NLP impacts the quality of external auditing

Hypothesis 03: The integration of NLP enhances the quality and accuracy of external auditing.

Table24 : *Variance ANOVA NLP*

Source	Sum of Squares	df	Mean Square	F	Sig.
Regression	8.074	1	8.074	61.508	0.000
Residual	1.313	10	0.131		
Total	9.387	11			

Source: Prepared by the student, based on SPSS software

The regression analysis reveals a highly significant relationship between NLP and audit quality ($F = 61.508$, $p < 0.001$). This indicates that NLP strongly improves the quality and accuracy of external audit outputs.

NLP enhances the analysis of textual and financial documents, improves audit evidence interpretation, and reduces human errors, thereby increasing audit reliability and quality. Overall, the third hypothesis is confirmed.

2.2. Multiple Linear Regression Analysis

2.2.1. Correlation and Model Summary

Table25 : *Model Summary*

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	0.763	0.582	0.560	0.484

Source: Prepared by the student, based on SPSS software.

The correlation coefficient R = 0.763 indicates a strong positive relationship between Artificial Intelligence (ADA, RPA, NLP) and audit efficiency. This suggests that an increase in AI adoption is associated with higher audit efficiency.

The coefficient of determination $R^2 = 0.582$ shows that 58.2% of the variation in audit efficiency is explained by the three AI dimensions. The adjusted R^2 (0.560) confirms the robustness of the model after adjusting for the number of predictors.

2.2.2. ANOVA Test

The Analysis of Variance (ANOVA) test is an important statistical procedure used in regression analysis to evaluate the overall significance of the regression model. It determines whether the independent variables collectively have a significant effect on the dependent variable.

In this study, the ANOVA test was used to examine whether the Artificial Intelligence dimensions, namely Artificial Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP), significantly influence audit performance.

The test is based on the F statistic and its significance value (Sig.). If the significance level is lower than 0.05, the regression model is considered statistically significant, which means that the independent variables jointly explain a meaningful proportion of the variation in the dependent variable.

Table26 *: Variance ANOVA*

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	18.325	3	6.108	26.037	0.000
Residual	13.138	56	0.235		
Total	31.463	59			

Source: Prepared by the student, based on SPSS software

The ANOVA results show that the model is statistically significant with F = 26.037 and p = 0.000 (< 0.05). This confirms that ADA, RPA, and NLP jointly have a significant effect on audit efficiency.

2.2.3. Regression Coefficients and Collinearity Statistics

The regression coefficients and collinearity statistics are important components of multiple regression analysis used to evaluate the relationship between the independent and dependent variables. The regression coefficients measure the direction, strength, and statistical significance of the effect of each predictor variable on audit performance, while the collinearity statistics assess the degree of correlation among the independent variables to ensure the reliability and validity of the regression model.

In this study, these statistics were used to examine the impact of Artificial Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP) on external auditing, as well as to verify the absence of serious multicollinearity problems between the AI dimensions.

***Table27** : Regression Coefficients and Collinearity Statistics*

Model	Variables	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	Constant	1.540	0.278	—	5.541	0.000	—	—
	ADA	0.603	0.071	1.681	8.506	0.000	0.191	3.238
	RPA	0.604	0.070	1.721	8.638	0.000	0.188	4.322
	NLP	0.626	0.083	1.269	7.563	0.000	0.265	3.773

Source: Prepared by the student, based on SPSS software.

The regression coefficients indicate that all Artificial Intelligence dimensions have a positive and statistically significant impact on audit performance.

The constant coefficient is equal to 1.540, representing the expected value of audit performance when all independent variables are equal to zero.

The coefficient for ADA is 0.603, meaning that a one-unit increase in ADA leads to an increase of 0.603 in audit performance, holding other variables constant. The variable is statistically significant with t = 8.506 and p = 0.000.

Similarly, RPA has a coefficient of 0.604, indicating a positive and significant contribution to audit performance. It records the highest standardized coefficient (Beta = 1.721), which suggests that RPA has the strongest explanatory effect among the independent variables.

The coefficient for NLP is 0.626, confirming a positive and statistically significant relationship with audit performance ($p = 0.000$).

Regarding multicollinearity diagnostics, the Variance Inflation Factor (VIF) values range between 3.238 and 4.322, which are below the critical threshold of 10. Likewise, tolerance values are above the minimum acceptable level of 0.10. Therefore, the model does not suffer from serious multicollinearity problems, and the regression estimates can be considered reliable.

2.2.4.Multiple Regression Equation

$$\mathbf{Audit=1.540+0.603(ADA)+0.604(RPA)+0.626(NLP)}$$

These results confirm that Artificial Intelligence technologies significantly and positively influence auditing practices.

The empirical results confirm that all AI dimensions (ADA, RPA, NLP) have a strong, positive, and statistically significant impact ($p < 0.001$) on auditing practices.

The model explains a substantial proportion of variance in audit efficiency ($R^2 = 58.2\%$), demonstrating the strategic role of Artificial Intelligence in transforming modern auditing processes.

3.Synthesis and Interpretation of Results

The purpose of this empirical study was to examine the impact of Artificial Intelligence technologies on the effectiveness of external auditing practices in major Algerian companies. The analysis focused on three main AI dimensions, namely Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP), in order to evaluate their influence on anomaly detection, risk assessment, audit efficiency, productivity, and audit quality.

The statistical analysis began with the examination of correlations between the study variables. The Pearson correlation results revealed positive and statistically significant relationships between external auditing practices and all AI technologies included in the study. The correlation between Audit and ADA was moderate and positive ($r = 0.637$, $p = 0.001$), indicating that the use of data analytics contributes to improving auditors' ability to identify anomalies, analyse large volumes of financial data, and strengthen risk assessment procedures. This result supports the first hypothesis, which states that the integration of Audit Data Analytics significantly improves anomaly detection and risk assessment in auditing.

The relationship between Audit and RPA was also strong and statistically significant (r = 0.709, p = 0.000). This finding demonstrates that Robotic Process Automation improves the efficiency and productivity of audit engagements by automating repetitive and time-consuming tasks such as data extraction, reconciliation, and documentation. This result validates the second hypothesis, which proposes that the integration of RPA significantly enhances the productivity and efficiency of audit tasks.

The strongest correlation was observed between Audit and NLP (r = 0.927, p = 0.000), reflecting the important role of Natural Language Processing in modern auditing practices. NLP technologies enable auditors to process unstructured textual information such as contracts, financial reports, emails, and audit documentation. The very strong correlation confirms that NLP significantly enhances the quality and accuracy of external auditing, thereby supporting the third hypothesis.

The regression analysis further confirmed the significant influence of Artificial Intelligence technologies on audit performance. The multiple regression model produced a strong correlation coefficient (R = 0.763), indicating a high level of association between the independent variables and audit effectiveness. The coefficient of determination (R^2 = 0.582) demonstrated that 58.2% of the variation in audit effectiveness is explained collectively by ADA, RPA, and NLP. This represents substantial explanatory power and confirms the strategic importance of AI technologies in transforming external auditing practices.

The ANOVA results supported the validity of the regression model. The calculated F statistic (F = 26.037) with a significance level of p = 0.000 confirmed that the regression model is statistically significant. Therefore, the AI dimensions jointly exert a meaningful influence on audit performance, validating the overall research model.

The regression coefficients provided additional insight into the individual contribution of each AI dimension. ADA recorded a positive and statistically significant coefficient (B = 0.603, p = 0.000), confirming its contribution to anomaly detection and risk assessment. This indicates that increasing the use of analytical technologies improves auditors' capacity to identify irregular transactions and evaluate financial risks more accurately.

RPA also showed a strong positive and significant effect on audit performance (B = 0.604, p = 0.000). Moreover, RPA obtained the highest standardized coefficient (Beta = 1.721), suggesting that automation technologies have the strongest explanatory effect among the independent variables. This demonstrates the critical role of automation in improving productivity, accelerating audit procedures, and reducing operational inefficiencies.

Similarly, NLP recorded a positive and statistically significant effect (B = 0.626, p = 0.000), highlighting its importance in improving audit quality and enhancing the reliability of audit evidence. NLP technologies improve auditors' ability to analyse complex textual data and support more accurate audit conclusions.

The multicollinearity diagnostics confirmed the reliability of the regression model. All VIF values ranged between 3.238 and 4.322, remaining below the critical threshold of 10, while tolerance values exceeded the minimum acceptable level of 0.10. These findings indicate the absence of serious multicollinearity problems among ADA, RPA, and NLP, confirming that the regression estimates are statistically reliable.

Overall, the findings of this study confirm the acceptance of all research hypotheses. The results demonstrate that ADA significantly improves anomaly detection and risk assessment, RPA enhances the efficiency and productivity of audit tasks, and NLP improves the quality and accuracy of external auditing. Consequently, Artificial Intelligence technologies represent essential tools for modern auditing practices by improving efficiency, strengthening audit quality, and supporting more reliable and data-driven audit processes in the Algerian context.

Conclusion

This chapter presented the empirical framework of the study through three complementary sections dedicated to the research methodology, descriptive statistical analysis, and hypothesis testing. The methodological section explained the quantitative approach adopted, the questionnaire design, the sample selection process, and the statistical tools used for data analysis. The descriptive analysis revealed that respondents generally possess a good level of knowledge regarding Artificial Intelligence technologies and hold positive perceptions toward their contribution to improving external auditing practices. The statistical tests further confirmed the existence of significant positive relationships between Artificial Intelligence technologies namely Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP) and the effectiveness of external auditing practices. The regression results demonstrated that AI technologies contribute significantly to improving audit efficiency, anomaly detection, risk assessment, and the quality and reliability of audit evidence. Overall, the findings confirm the growing importance of Artificial Intelligence in transforming modern auditing practices and enhancing the effectiveness of external auditing within the Algerian context.

General Conclusion

The role of external auditing in ensuring financial transparency, reliability, and credibility remains essential for maintaining trust in economic systems and supporting sound corporate governance. In a rapidly evolving digital environment, the auditing profession is increasingly influenced by technological innovation, particularly through the emergence of Artificial Intelligence technologies. These transformations are progressively reshaping traditional audit methodologies and creating new opportunities for improving audit quality and efficiency.

Within this context, this research addressed the following research problem: **"To what extent does the use of Artificial Intelligence transform auditing practices, and what are its effects on the quality, reliability, and integrity of audit engagements in the Algerian context?"** In order to answer this question, the study was structured into three complementary chapters combining both theoretical and empirical perspectives.

The first chapter focused on the theoretical framework of external auditing. It presented the fundamental concepts of auditing, its objectives, principles, and professional standards, while also highlighting the limitations of traditional audit approaches in increasingly digitalized business environments. This chapter provided a comprehensive understanding of the evolution of auditing practices and the growing need for technological integration within the profession.

The second chapter examined Artificial Intelligence and its applications in auditing practices. Particular attention was given to the main AI technologies used in auditing, namely Audit Data Analytics (ADA), Robotic Process Automation (RPA), and Natural Language Processing (NLP). This chapter demonstrated how these technologies contribute to automating repetitive tasks, improving data analysis, strengthening anomaly detection, and enhancing risk assessment procedures. It also highlighted the opportunities provided by AI in terms of audit efficiency and decision making, while discussing challenges related to cybersecurity, technological adaptation, and professional competencies.

The third chapter was dedicated to the empirical study conducted through a questionnaire distributed to auditors and accounting professionals in Algeria. The collected data were analysed in order to evaluate the relationship between Artificial Intelligence and audit effectiveness and to test the research hypotheses formulated at the beginning of the study.

The findings of the study indicate that the integration of Artificial Intelligence technologies contributes positively to improving external audit practices. The results show that AI enhances anomaly detection and risk assessment processes, improves the quality and reliability of audit evidence, and increases the efficiency of audit engagements by facilitating

the processing and analysis of large volumes of data. Furthermore, the study reveals that the adoption of Artificial Intelligence is progressively transforming the competencies required from auditors and influencing their professional role within digital audit environments.

Based on the obtained results, the hypotheses formulated in this study can be summarized as follows:

- **The first hypothesis**, which stated that the integration of ADA significantly improves anomaly detection and risk assessment in external auditing, was confirmed;
- **The second hypothesis**, which assumed that the integration of RPA significantly enhances productivity of audit tasks, was also validated;
- **The third hypothesis**, suggesting that the integration of NLP enhances the quality and accuracy of external auditing was also validated.

Research Limitations

This study encountered several limitations that may have influenced the research process and the interpretation of the findings. First, the limited time available for conducting the empirical investigation constrained the data collection and analysis phases. Second, some auditors and professionals were reluctant to collaborate or complete the questionnaire, which reduced the ease of obtaining a larger sample size.

Another limitation concerns the varying levels of technological awareness among respondents. Some participants lacked sufficient training or familiarity with Artificial Intelligence technologies, which may have affected their ability to fully understand certain concepts related to ADA, RPA, and NLP. In addition, difficulties were encountered during the statistical analysis process, particularly regarding the use of SPSS software, data coding, and database management.

Furthermore, the study focused mainly on major Algerian companies, which may limit the generalization of the findings to smaller firms or other sectors. The limited availability of local academic and professional studies related to Artificial Intelligence in auditing within the Algerian context also represented a challenge during the theoretical review.

Research Perspectives

Based on these limitations, several future research perspectives can be proposed. Future studies could expand the sample size by involving a larger number of auditors, accounting professionals, and audit firms from different sectors and regions of Algeria. Researchers may

also conduct comparative studies between Algeria and other countries to evaluate differences in AI adoption and auditing practices.

In addition, future research could focus on other Artificial Intelligence technologies beyond ADA, RPA, and NLP, such as blockchain, deep learning, and expert systems in auditing. Further studies may also examine the impact of AI on auditor ethics, cybersecurity, professional judgment, and audit independence.

Moreover, future research could adopt qualitative approaches, such as interviews and case studies, to gain deeper insights into the practical challenges of AI integration in auditing firms. Finally, additional studies are recommended to evaluate the effectiveness of professional training programs and regulatory frameworks aimed at supporting the digital transformation of the auditing profession in Algeria.

recommendations can be proposed for Algerian audit firms and organizations

- Strengthen the integration of Artificial Intelligence technologies in audit processes through the adoption of advanced analytical and automation tools adapted to the Algerian professional environment;
- Invest in continuous professional training programs in order to develop auditors digital and analytical competencies related to Artificial Intelligence applications;
- Encourage collaboration between audit firms, universities, and technology providers to promote innovation and facilitate knowledge transfer in AI-related audit practices;
- Establish stronger cybersecurity policies and digital risk management systems to ensure the protection and confidentiality of financial and audit data;
- Develop professional and regulatory frameworks capable of accompanying the digital transformation of auditing practices in Algeria.

However, this study presents certain limitations that should be acknowledged. First, the sample size remains relatively limited, which may affect the generalizability of the findings. Second, the research relied mainly on a quantitative approach based on questionnaire data, which may not fully capture the complexity of auditors' perceptions and experiences regarding Artificial Intelligence adoption. In addition, the varying levels of familiarity with AI technologies among respondents may have influenced their evaluations and responses.

Finally, this research opens several perspectives for future studies. Future research could examine the impact of Artificial Intelligence on auditor client relationships, investigate the level of digital maturity among Algerian audit firms, or explore the role of AI in improving fraud

detection and predictive auditing practices. Further studies may also focus on regulatory and ethical issues associated with Artificial Intelligence adoption in auditing environments.

In conclusion, Artificial Intelligence represents both a major opportunity and a significant challenge for the future of external auditing. While AI technologies contribute to improving audit efficiency, reliability, and analytical capabilities, their successful integration depends on the ability of audit professionals and organizations to adapt to technological change and develop the necessary competencies required in increasingly digitalized audit environments.

Bibliography

bibliography

1. (s.d.). Récupéré sur https://www.wallstreetmojo.com/internal-audit-vs-external-audit/.
2. B.Anderson. (1977). *Auditing: A Practical Approach.* London, UK: Pitman Publishing.
3. Bertin, E., Christophe , C., & Rédha , R. (2013). *Manuel de comptabilité et d'audit.* Alger: Berti Editions.
4. Committee on Basic Auditing Concepts. (1973). *A Statement of Basic Auditing Concepts.* Sarasota, Florida, USA: American Accounting Association.
5. Conseil National de la Comptabilité. (2016). *Normes algériennes d'audit (NAA).* Algérie: Ministère des Finances.
6. Dell, S., & Mfon , A. (2024). *ChatGPT and AI for Accountants.* Birmingham: Packt Publishing Ltd.
7. Grenier, C., & Bonnebouche, J. (1996). *Auditeur opérationnel : efficacité, efficience ou sécurité.* Paris, France: Economica.
8. IEEE Corporate Advisory Group (CAG). (2017). *Artificial Intelligence: Emerging Opportunities, Challenges and Policy Implications.* New York: Institute of Electrical and Electronics Engineers (IEEE).
9. International Auditing and Assurance Standards Board (IAASB). (2010). *International Standard on Auditing 200.* New York, NY, USA: International Federation of Accountants (IFAC).
10. International Auditing and Assurance Standards Board (IAASB). (2010). *International Standard on Auditing 200: Overall objectives of the independent auditor and the conduct of an audit in accordance with International Standards on Auditing (ISA 200).* New York, NY: International Federation of Accountants (IFAC).
11. International Ethics Standards Board for Accountants (IESBA). (2018). *International code of ethics for professional accountants™ (including international independence standards™).* New York, New York 10017 USA: International Federation of Accountants.
12. International Federation of Accountants(IFAC). (2023). *Handbook of International Quality Management, Auditing, Review, Other Assurance, and Related Services Pronouncements (Volume 1).* New York: International Federation of Accountants.

13. Jakob, M. (2023). Auditing of AI: Legal, ethical and technical approaches. *Digital Society*.

14. Joakim, L., Minkkinen, M., & Mäntymäki, Matti, M. (2023). Ethics-based AI auditing: A systematic literature review on conceptualizations of ethical principles and knowledge contributions to stakeholders. *Elsevier*.

15. Krothapalli, V. R. (2025). *Mastering Cloud Auditing.* india: BPB Publications.

16. Lacolare, V. (2010). *Pratique de l'audit à valeur ajoutée.* Paris, France: AFNOR.

17. Leocádio, D., Malheiro, L., & Reis, J. (2024). Artificial Intelligence in Auditing: A Conceptual Framework for Auditing Practices. *Administrative sciences*.

18. Lubis, A. F., & Renny , M. (2024). *The Evolution of External Auditing: Challenges and Opportunities in a Digitalized Financial Environment.* Medan, Indonesia: Universitas Pembangunan Panca Budi.

19. Manheim, D., Martin, S., Bailey, M., Samin, M., & Greutzmacher, R. (2025). The necessity of AI audit standards boards. *Springer*.

20. Matthews, D. (2006). *A History of Auditing.* 2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN: Routledge.

21. Naqvi, A. S. (2020). *Artificial Intelligence for Audit, Forensic Accounting, and Valuation: A Strategic Perspective.* Hoboken, New Jersey: John Wiley & Sons.

22. Office de la Formation Professionnelle et de la promotion du Travail (OFPPT). (2023). *Module 302: Realisation un Audit Comptable et financier* . Casablanca, Morocco: Direction de La Recherche et Ingenierie de formation .

23. Porter, B., Jon, S., & David, H. (2014). *Principles of External Auditing.* United Kingdom: John Wiley & Sons Ltd.

24. Ramaswamy, J. (2026). *Mastering the IT Audit.* India: BPB Publications.

25. Ranjan, P., Brij , K., & Rajiv , A. (2025). *Artificial Intelligence and Financial Security: Harnessing AI to Protect and Optimize Financial Systems.* India: BPB Publications.

26. S, S. D., Kelley , S., & Camacho Ibáñez, J. (2024). The emergence of artificial intelligence ethics auditing. *Big Data & Society*.

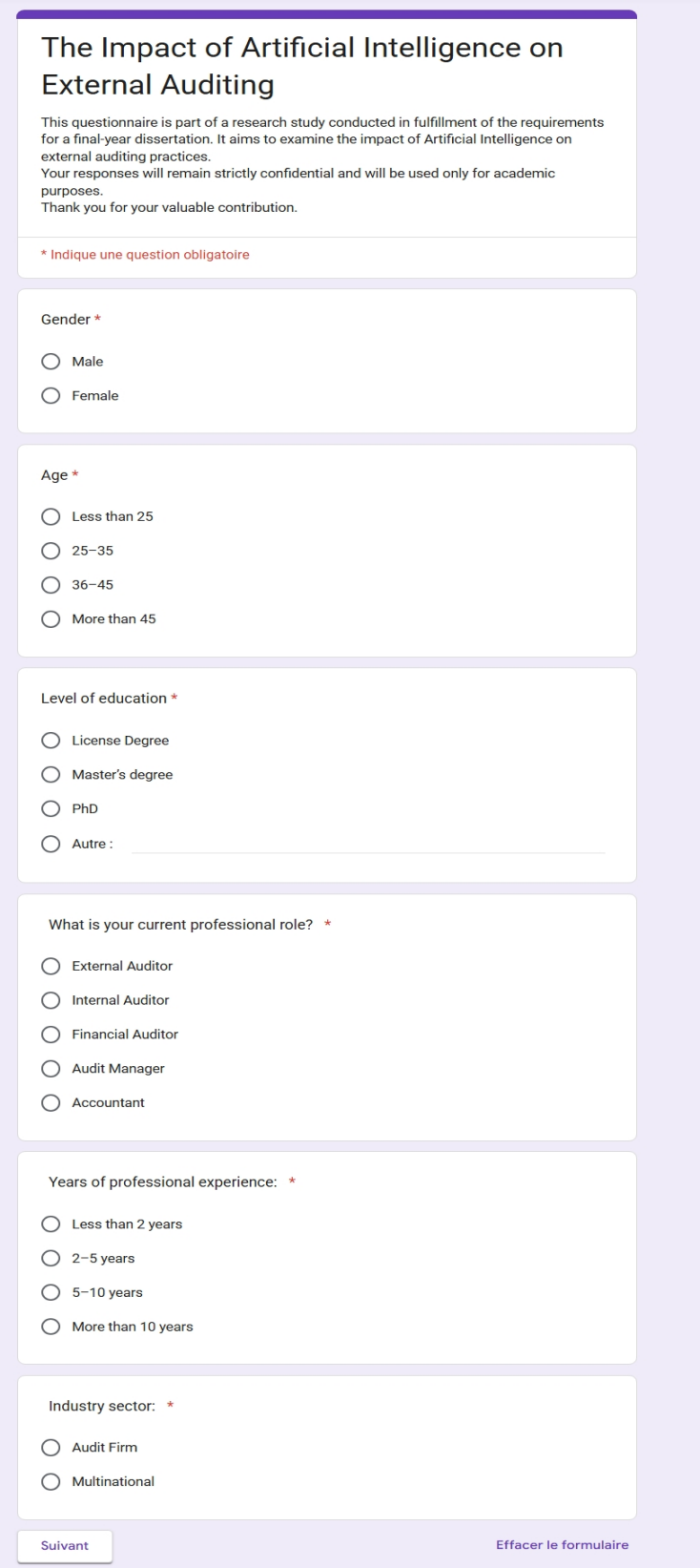
27. Sundarasen, S., Kamaludin, K., & Deepa , N. (2024). From adoption to audit quality: Mapping the intellectual structure of artificial intelligence-enabled auditing. *Risk and Financial Management* .

28. Tounès, A. (2003). *L'intention entrepreneuriale : Une recherche comparative entre des étudiants suivant des formations en entrepreneuriale(bac+5) et des et des étudiants en DESS CAAE, Thèse pour le doctorat en Sciences de Gestion.* Université de Rouen.

29. Venkatasubramanian, G. (2023). AI in auditing: A comprehensive review of application, benefits and challenges. *International Council for Education Research and Training (ICERT) / Shodh Sari – An International Multidisciplinary Journal*.

Appendices

Appendix 1 : *Research Questionnaire*



The Impact of Artificial Intelligence on External Auditing

This questionnaire is part of a research study conducted in fulfillment of the requirements for a final-year dissertation. It aims to examine the impact of Artificial Intelligence on external auditing practices.
Your responses will remain strictly confidential and will be used only for academic purposes.
Thank you for your valuable contribution.

* Indique une question obligatoire

Gender *

- ◯ Male
- ◯ Female

Age *

- ◯ Less than 25
- ◯ 25–35
- ◯ 36–45
- ◯ More than 45

Level of education *

- ◯ License Degree
- ◯ Master's degree
- ◯ PhD
- ◯ Autre :

What is your current professional role? *

- ◯ External Auditor
- ◯ Internal Auditor
- ◯ Financial Auditor
- ◯ Audit Manager
- ◯ Accountant

Years of professional experience: *

- ◯ Less than 2 years
- ◯ 2–5 years
- ◯ 5–10 years
- ◯ More than 10 years

Industry sector: *

- ◯ Audit Firm
- ◯ Multinational

Suivant Effacer le formulaire

The Impact of Artificial Intelligence on External Auditing

* Indique une question obligatoire

The use of AI Tools

What is your level of knowledge regarding AI tools in auditing? *

- ◯ Low
- ◯ Medium
- ◯ Good
- ◯ Advanced

Which of the following AI tools do you use? *

- ◯ Audit Data Analytics (ADA)
- ◯ Robotic Process Automation (RPA)
- ◯ Natural Language Processing (NLP)

Retour Suivant Effacer le formulaire

Audit Data Analytics (ADA)

This section focuses on the use of Audit Data Analytics (ADA) in enhancing audit quality and decision-making. ADA involves the application of analytical techniques to examine large volumes of financial and non-financial data in order to identify patterns, anomalies, and risks. The objective is to evaluate how auditors perceive the usefulness and effectiveness of data-driven audit approaches.

The use of ADA Helps in *

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The use of ADA improves the efficiency of audit tasks.	○	○	○	○	○
ADA enhances the detection of anomalies and errors in financial data.	○	○	○	○	○
ADA contributes to more effective risk assessment.	○	○	○	○	○
ADA reduces the time required to perform audit procedures.	○	○	○	○	○

Robotic Process Automation (RPA)

This section aims to assess the extent to which Robotic Process Automation (RPA) is utilized in auditing practices. RPA refers to the use of software robots to automate repetitive, rule-based tasks such as data extraction, reconciliation, and documentation. The questions explore auditors' perceptions of RPA's efficiency, accuracy, and its impact on audit processes.

The use of RPA Helps in *

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
RPA automates repetitive tasks in the auditing process.	○	○	○	○	○
RPA improves the efficiency and speed of audit procedures.	○	○	○	○	○
RPA allows auditors to focus on higher-value analytical tasks.	○	○	○	○	○
The use of RPA requires auditors to develop new technical competencies.	○	○	○	○	○

Natural Language Processing (NLP)

This section examines the role of Natural Language Processing (NLP) in audit activities. NLP is a branch of artificial intelligence that enables machines to understand, interpret, and analyze textual data such as contracts, reports, and emails. The questions aim to capture auditors' views on the relevance, reliability, and practical applications of NLP in audit procedures.

The use of NLP Helps in *

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
NLP improves the analysis of financial and textual audit documents.	○	○	○	○	○
NLP enhances the quality of audit evidence.	○	○	○	○	○
NLP provides valuable insights for audit decision-making.	○	○	○	○	○
NLP reduces human errors in document analysis.	○	○	○	○	○

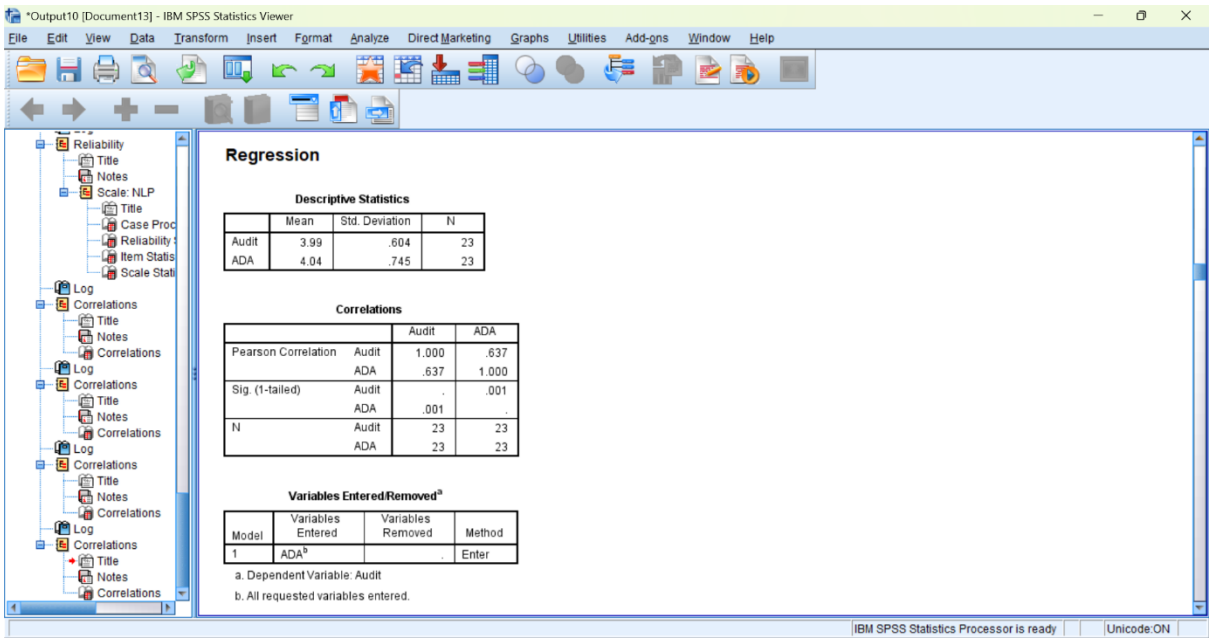
Impact of AI Tools on External Auditing Practices

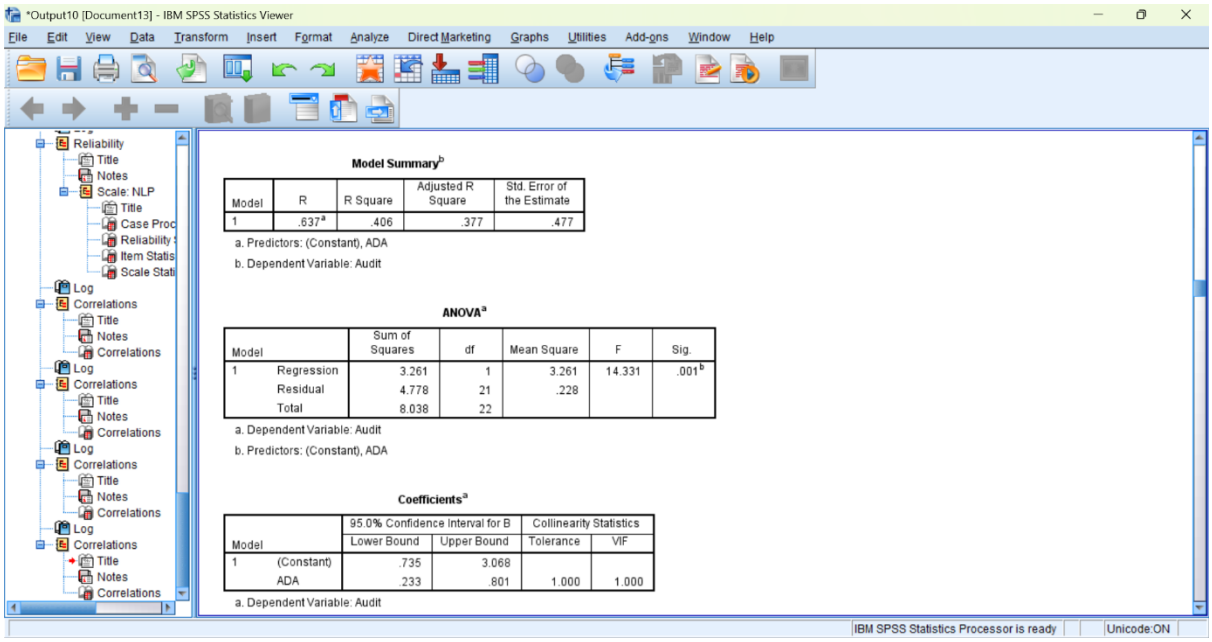
This section aims to evaluate the perceived impact of advanced technologies—such as Robotic Process Automation (RPA), Audit Data Analytics (ADA), and Natural Language Processing (NLP)—on the quality and effectiveness of external auditing practices. It focuses on how these tools influence audit performance, reliability of evidence, risk detection, and overall audit outcomes.

Overall Impact of AI on external auditing *

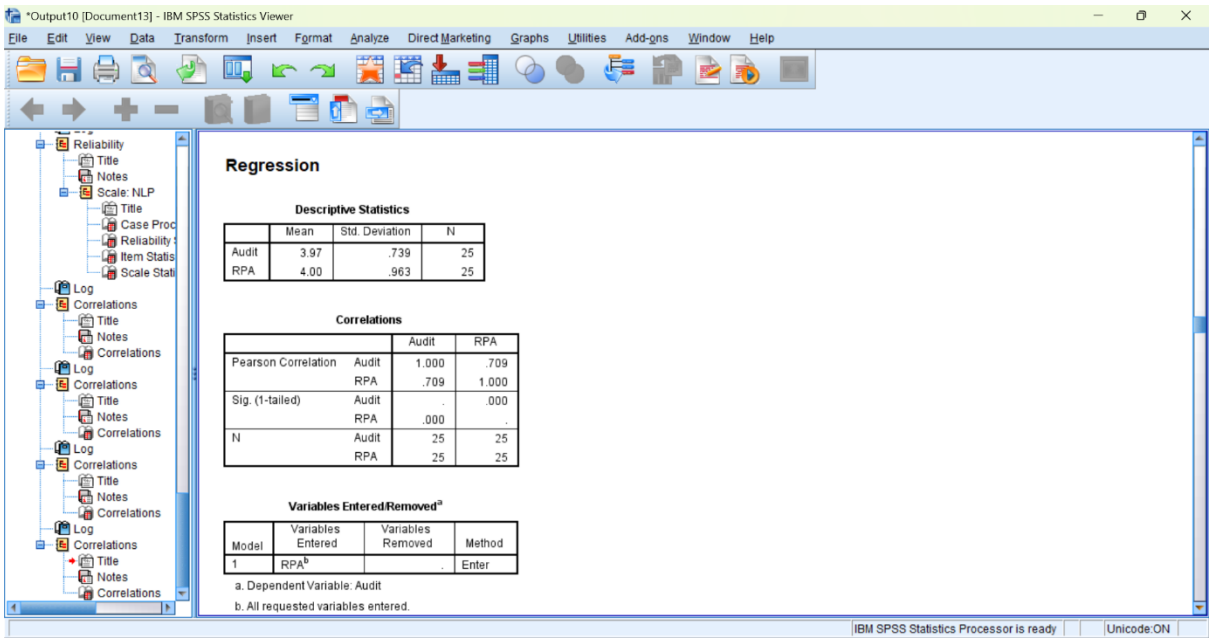
	Strongly agree	Agree	Neutral	Disagree	Strongly Disagree
The use of AI-based tools improves The use of AI-based tools improves the overall quality of external audits.	○	○	○	○	○
AI tools enhance the reliability of audit evidence obtained during the audit process.	○	○	○	○	○
AI technologies improve the auditor's ability to detect errors, fraud, and anomalies.	○	○	○	○	○
The use of AI tools increases the efficiency of audit procedures.	○	○	○	○	○
AI tools enable auditors to save time and complete audit engagements more quickly.	○	○	○	○	○

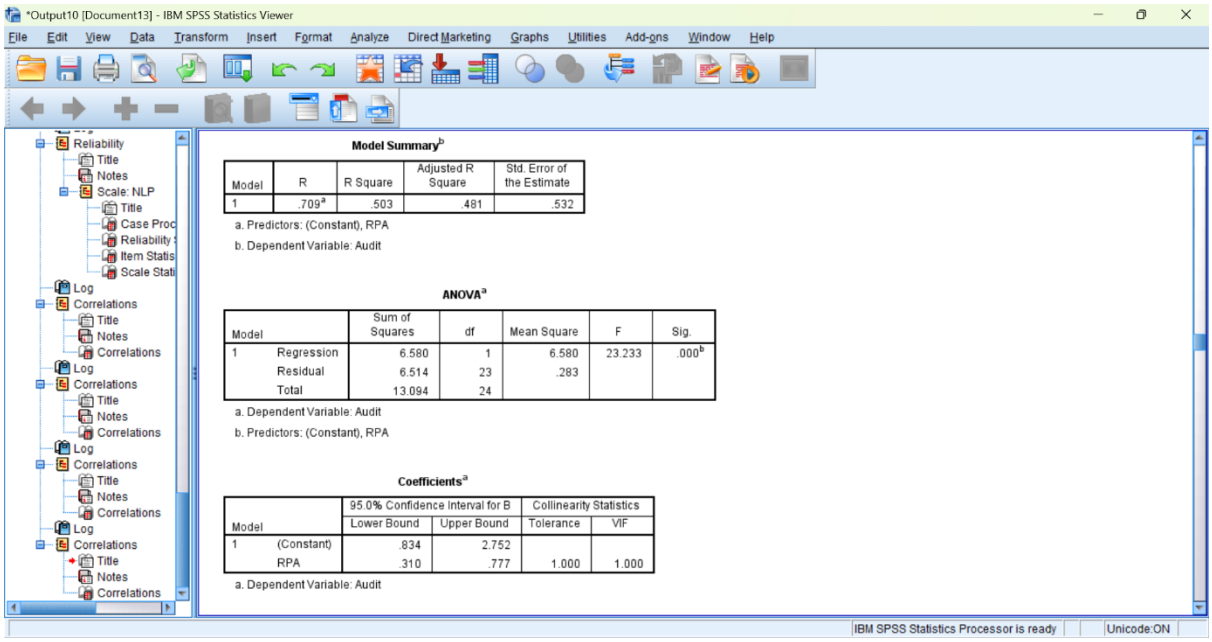
Appendix 2 : *Regression Analysis Results of ADA*



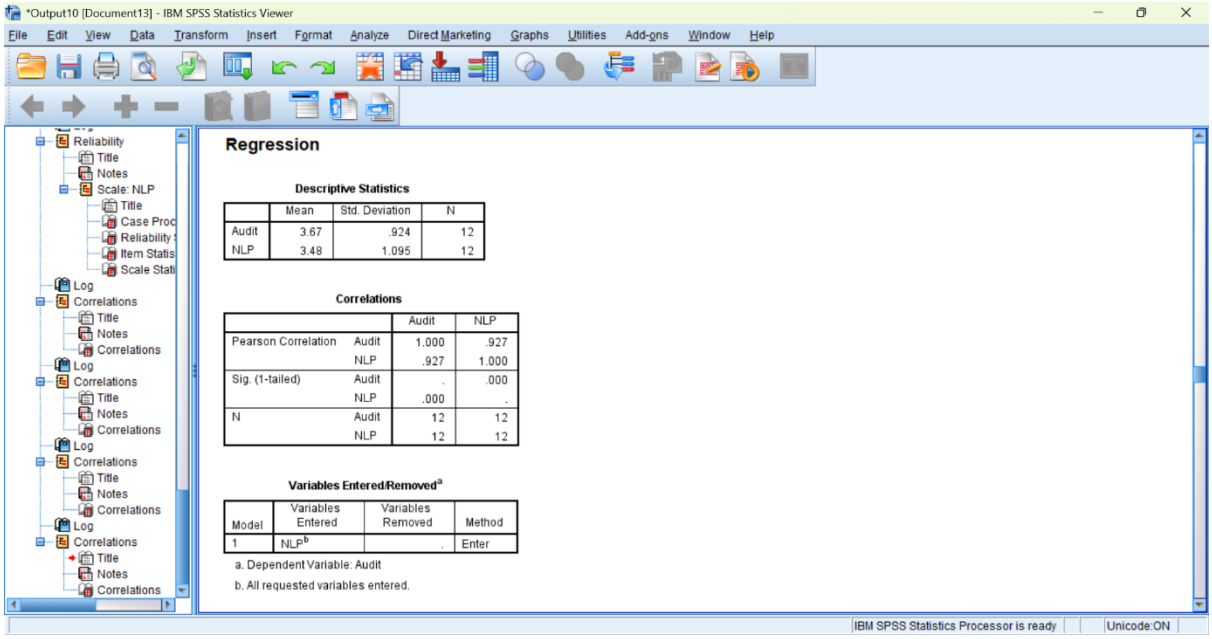


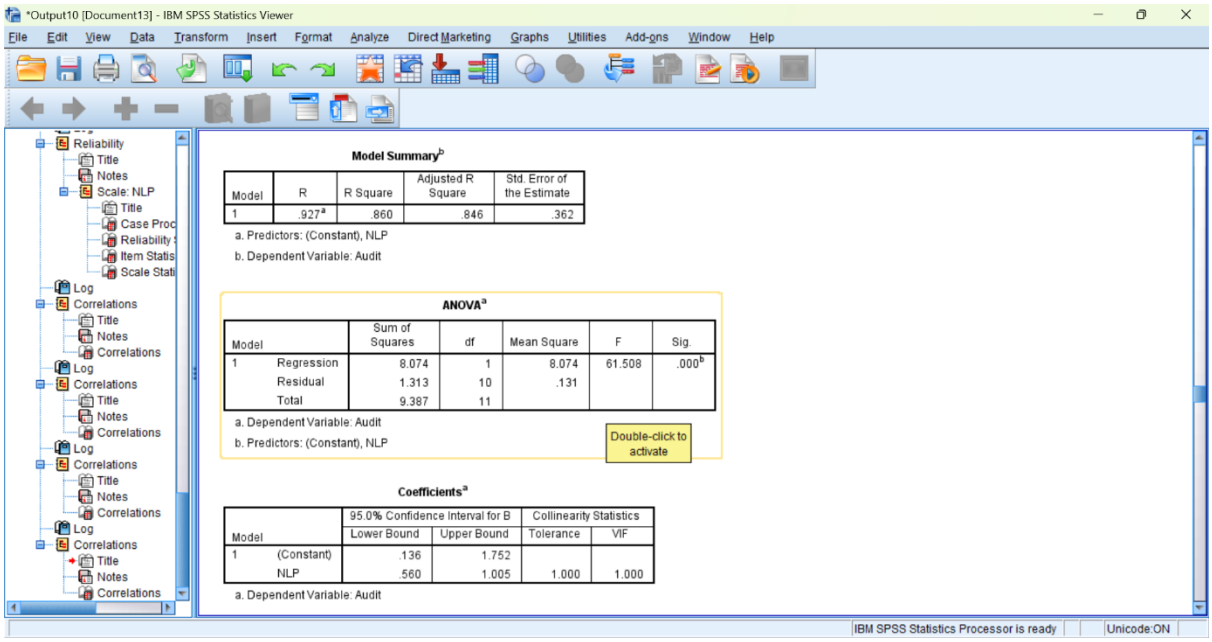
Appendix 3 *: Regression Analysis Results of RPA*





Appendix 4 *: Regression Analysis Results of NLP*





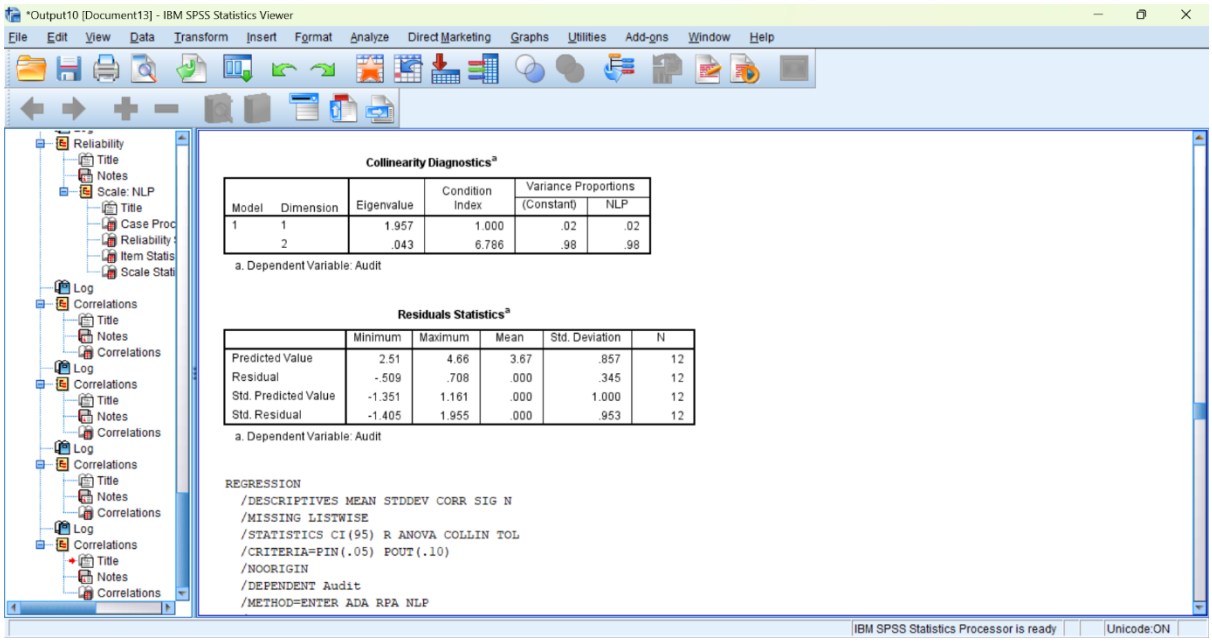

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Title
Case Proc
Reliability
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Correlations
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IBM SPSS Statistics Processor is ready
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