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Artificial Intelligence in Auditing: Opportunities, Challenges, and the MindBridge Case

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Firma (signature) Sofia Miotto

A mio nonno Lino, il cui coraggio e forza mi guidano ogni giorno.

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Abstract

L’obiettivo di questa tesi è analizzare come l’Intelligenza Artificiale (IA) stia trasformando le procedure di auditing e, al contempo, ridefinendo il ruolo dei revisori contabili in un contesto sempre più digitalizzato. Dopo una breve introduzione sull’ascesa dell’IA nei settori professionali, in particolar modo nella revisione contabile, l’elaborato si focalizza sulle tecnologie chiave che ne sono alla base: Machine Learning (ML) e Natural Language Processing (NLP). Queste tecnologie stanno ridefinendo l’intero processo di audit attraverso l’automazione, l’analisi predittiva e il rilevamento delle anomalie. La ricerca propone un confronto tra l’audit tradizionale, spesso caratterizzato da elevati volumi di dati, procedure laboriose e un significativo margine di errore umano, e un approccio innovativo basato sull’IA, contraddistinto da maggior efficienza, rapidità e precisione operativa. A supporto dell’analisi teorica, viene presentato un caso studio sulla piattaforma Mindbridge AI, che dimostra come l’integrazione di analisi statistica, logica normativa e algoritmi di machine learning, possa migliorare l’efficacia, l’accuratezza e l’oggettività delle attività di revisione contabile. MindBridge AI si distingue per l’impiego di punteggi di rischio guidati dai dati capaci di supportare la valutazione del rischio intrinseco nei processi di audit. Il caso studio in questione evidenzia anche alcune limitazioni dovute alla dipendenza della qualità dei dati e l’importanza del giudizio professionale. In questo contesto, la tesi esamina i principali vantaggi e le criticità derivanti dall’adozione dell’Intelligenza Artificiale nel mondo dell’audit.
Infine, la conclusione delinea gli scenari futuri, considerando tanto i potenziali sviluppi tecnologici quanto le implicazioni etiche, con l’obiettivo di massimizzare il valore dell’IA applicata all’auditing.

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1. INTRODUCTION

In recent years, the exponential growth of Artificial Intelligence (AI) has provoked a deep transformation among everyone's life. Across all sectors, AI is reshaping work methodologies by enhancing productivity, minimizing errors, boosting velocity. Among these fields, AI is showing an incredible potential in the audit process, known to be traditionally manual and strictly ruled-based.

The subject of this thesis is how Artificial Intelligence (AI) is reshaping the audit process. This match is incredibly functional, resulting in boosting audit's accountability and transparency with a really precise cutting-edge technology. In the big data era, businesses are relying more and more on digital infrastructures, exposing the limitations of traditional audit methods. AI emerges as the perfect alternative to enhance accuracy, increase efficiency and allowing for more strategic focus among auditors.

Today, AI is reshaping nearly every professional field. Technologies such as Machine Learning (ML) and Natural Language Processing (NLP) have marked a significant step forward in processing large datasets and detecting anomalies. These tools enable auditors to move beyond traditional audit techniques, performing a continuous and real-time analysis.

Before the introduction of AI tools, auditors mainly rely on document-centric review processes and manual controls which cannot check entire datasets due to time and resource constraints. This traditional approach was unable to capture anomalies hidden in massive datasets. A clear example is the global financial scandal of WorldCom in 2002, the second largest long distance telecommunications company that had overstated earnings for $3.8 billion. This event highlights the vulnerabilities of conventional auditing and the urgent need for an innovative process. And, it also paved the way for the development of AI in auditing, allowing data-driven and real-time analysis (Lyke n.d.).

The objective of this thesis is to analyze how AI is reshaping the auditing field, both theoretically and practically. It includes overview of key AI concepts, with particular attentions to Machine Learning (ML) and Natural Language Processing (NLP). Moreover, also Robotic Process Automation (RPA), Predictive Analysis (PA) and Anomaly Detection (AD), are essential for the implementation of AIdriven platforms such as MindBridge, an AI-auditing platform adopted by global leaders like KPMG. Sebastian Stöckle, Chief Technology Officer of KPMG, once said: "Our alliance with MindBridge will bring increased levels of AI into KPMG, allowing for improved risk identification, helping in the continued delivery of higher quality audits by combining KPMG firm's in-depth industry experience and MindBridge's advanced techniques. Working together we continue to digitally transform the audit, providing increased quality and value to clients and enhancing public trust".

By presenting a practical example, namely the MindBridge platform, the aim is to illustrate how AI has already changed several job procedures of accounting firms and auditing professionals worldwide. Nevertheless, there are also some limitations and challenges of implementing AI, including ethical concerns, data quality issues, and the importance of human judgement in final decision making.

Moreover, AI contributes to strengthening audit credibility and trust, essential elements for investor confidence and corporate governance. Thus, AI in auditing does not merely represent a technological

advancement but a shift in how the audit process is conceived, marked by transparency and minimization of subjective bias.

In conclusion, this thesis explore how AI is shaping the future of auditing and redefining the role of auditors. Professionals can focus on more strategic and high-value activities rather than repetitive tasks. Although AI marks a key milestone in improving the audit process, MindBridge's motto:
"Bridging the gap between human and artificial intelligence", highlights the essential interplay between human expertise and machine capabilities. AI enables the objective analysis of big-dataset with a speed and accuracy unattainable by humans. However, the professional judgement of auditors remains fundamental to interpreting results and making strategic decisions. As noted by Samiolo (2024), professional judgement is outside the tool, it enables us to exercise the judgment we have, underscoring the enduring value of auditor interpretative role.

2. ARTIFICIAL INTELLIGENCE AND AUDITING: AN INNOVATIVE MATCH

2.1 Definition of Artificial Intelligence

According to Naqvi Artificial Intelligence (AI) is the technology with the ability to achieve goals in uncertain environments. This definition is particularly relevant in the accounting field, where complexity and huge amount of data are part of daily operations. The definition highlights that we are witnesses of a technology that can not only replace human labor but also constantly learn from it and improve itself.
Haenlein and Kaplan (as cited in Zemánková, 2019) defined AI as:"The ability of a system to accurately understand external data, learn from it, and apply what it has learned to fulfill specific goals and tasks through flexible adaptation". Thus, AI is what allows machines to learn from their mistakes, adapt to new inputs and execute human-like jobs.

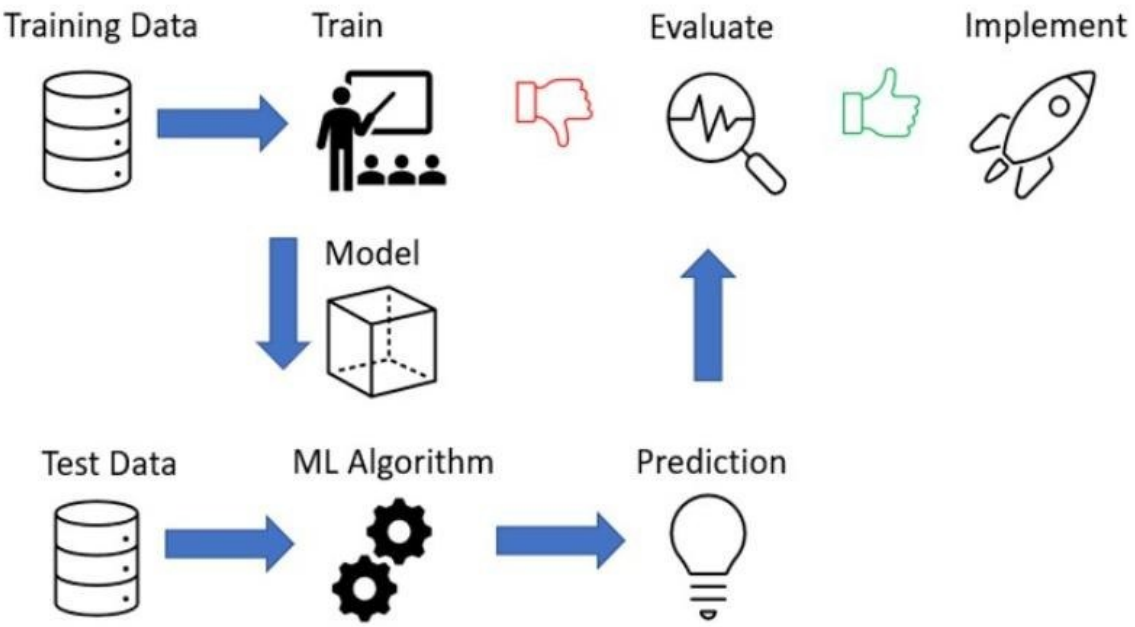
2.2 Machine Learning (ML)

Machine Learning (ML) is one area in the broad AI field and it derived from statistical learning methods. It focuses on developing learning algorithms that build models from data. In the era of big data, it is more effective to learn from data than to encode domain knowledge manually. This statistical approach allows the performance to get better overtime by learning from itself.
One of the earliest examples of machine learning system was a computer checkers game created by Arthus Lee Samuel at IBM. The computer learns by using the feedback from playing as its data and using Arthur's function to guide its prediction model (IAASB, 2022).

Machine Learning, in its simplest form, requires a five-step process:

- Get and organize the data
- Choose a model: one or more algorithms
- Train the model using training data, that are about 70% of the dataset
- Evaluate the model using test data, that are about 30% of the dataset
- Fine-tune the model and implement (IAASB, 2022)

Machine Learning Process



Source: IAASB. (2022). *Digital technology market scan: Artificial intelligence — A primer*. International Auditing and Assurance Standards Board. https://www.iaasb.org/publications/digital-technology-market-scan-artificial-intelligence-primer

There are several types of Machine Learning, determining which approach to use largely depends on what data you have available (IAASB, 2022).

- Supervised Learning: Used when the outcome is known and large amounts of labelled data are available, but the relationships between the input variables is uncertain. The algorithm is fed with inputs and possible outputs related to them. The objective is to create some common rules to identify and classify the given data. To take an example, when a loan applicant is asking a bank to extend a loan. In this case, the output is very clear (loan approval or rejection) but input's features are uncertain: the customer can whether successfully repay the loan or not. There are effectively two types of algorithms that are used with supervised learning. One is classification when the dataset is divided into common labels. A typical classification algorithm is called Naïve Bayes Classifier, which is used in text analysis: sentiment analysis and email spam detection. It uses frequency and patterns in data to come up with a prediction model based on probabilities. The other type of algorithm is linear regression that finds continuous patterns in data; it shows the relationship between variables and uses this to predict outcomes based on inputs (IAASB, 2022).

- Unsupervised Learning: Applied when the labelled data is not very common and the manual labelling data is also not cheap. In this case the possible outputs are unknown and the computer has to identify them. The algorithm tries to identify the recurring patterns in the data and thereby groups them in clusters with similar kinds of attitude. The most common approach is called Clustering, which is grouping similar items together and then iterating the model to get

better results. It is mainly used in customer segmentation for targeting marketing messages, where similar customer characteristics are expected to share similar preferences (IAASB, 2022).

- Reinforcement Learning: The software is stimulated with rewards and penalties. The algorithm is fed with information on reward definition that guide it through taking the steps to solve the problem. It's a never-ending learning process since it relies on received feedback to solve the problem. It is commonly used in gaining and robotics, effectively learning through a process of trial and error to get the most effective outcome (IAASB, 2022).

2.3 Natural Language Processing (NLP)

Natural Language Processing (NLP) is changing the way of interacting with technology, it provides to computer the ability to comprehend and answer to human language as human beings. There are mainly two types of data in this process:

- Structured data: tables, database with rows and columns that are easily elaborated
- Unstructured data: documents, emails, social media posts, difficult to be analyzed.

The Natural Language Understanding (NLU) is a process that transform the unstructured text in structured data, it allows the computer to extract significant information from human language: it is about machine comprehension. It involves grammar analysis and extraction of entities to understand the text meaning.

The Natural Language Generation (NLG) is the translation of structured data into unstructured texts: it is about machine expression. It is commonly used by Chatbot to generate correct and coherent answers.

There are some fundamental tools used by NLP that allows to analyze and comprehend human language effectively:

- Tokenization: the subdivision of a text into small units called token.
- Stemming: the reduction of words to their roots.
- Lemmatization, the transformation of words into their basic forms (Siddhartha, Niveditha, & Manu, 2021).
- Part of Speech Tagging such as the identification of parts of speech such as nouns, verbs, adjectives…
- Named Entity Recognition (NER) which is the identification of personal nouns, places, organizations, phone numbers…
- Sentiment Analysis which discover emotions and feelings hidden in the text by assigning them a label as positive, negative or neutral sentiments.
- Topic Modeling which provides the automatic identification of the main themes in the documents.
- Text summarization is essential to synthesize the key aspects of a text in a summary of all (Gunasekaran, 2023).

To sum up, the raw text is analyzed by the Natural Language Understanding through lexical and grammar analysis, then the extracted information is sent to the Natural Language Generation in order to build the syntactic structure and then generate the final text.

Since Enterprise Resource Planning (ERP) software are becoming more and more common in nowadays businesses, it is infeasible for auditor to manually audit all of them.

There are several ways in which Artificial Intelligence (AI) may be used to support the audit process. In particular, Natural Language Processing (NLP) and Machine Learning (ML) techniques are highly effective in analyzing both structured and unstructured information. Theses may include global regulatory notices, industry reports and regulatory penalties. Moreover, intelligent document analysis can derive insight from unstructured data sources like emails and documents to understand the entity's information system and related controls. The ability to summarize and extract key information reduce manual workload and also improves the consistency of audit evidence. Finally, AI can be used to support professional judgement by highlighting anomalies or indicators of risk in high risk areas such as revenue recognition and related transactions. (IAASB, 2022).

2.4 How Machine Learning is transforming the Audit Process: Automation, Predictive Analysis, Anomaly Detection

AI is being used by accounting firms to enhance audit processes, risk assessments, transaction tests, analytics, and audit work-paper preparation for improved accuracy and compliance (Oyeniyi, et al., 2024).

The integration of AI in accounting also extends to Robotic Process Automation (RPA), which automates repetitive and routine tasks like data entry, reconciliation, and report generation. The evolution of RPA in accounting is marked by its potential to automate a high volume of repetitive and rule-based tasks. The introduction of RPA goes beyond the mere automation of repetitive tasks: there is also a shift in task allocation that makes accountants life incredibly easier since they can focus more on strategic roles, thus enhancing workforce productivity. However, this evolution requires an improvement in the skill set of future accountants, prioritizing soft and data skills. (Oyeniyi, et al., 2024).

Predictive Analysis (PA) is at the base of AI-driven risk assessment. PA is crucial for forecasting forward outcomes through historical date, statistic algorithms and machine learning tools. In brief, PA is a tool that incorporates both the traditional audit background and the forward looking audit procedure. According to Mitan, J. (2024), firms using predictive analytics have seen a 30% increase in the accuracy of risk assessment, demonstrating how these tools surpass the capabilities of traditional sampling techniques.

Moreover, AI has significantly advanced fraud detection through anomaly detection algorithms and NLP tools. Natural Language Processing has expanded fraud detection by analyzing textual data such as contracts and emails. Leocádio et al. (2024, p.7) highlight how NLP systems detect suspicious language patterns, offering insights that go beyond numerical data.

3. TRADITIONAL AUDITING AND ITS LIMITATIONS

3.1 Overview of the Auditing Process

According to Naqvi (2020), audit is the foundation over which the entire global economy rests. Auditing is the process of reviewing financial statements prepared by management to determine if it

has been prepared in accordance with the accounting standards (Iris Stuart). Over the years, the first advancement in accounting was the invention of bookkeeping with double entries more than 500 years ago. Then in 1980s thanks to the introduction of electronic computers, auditing process became more time and cost saving. In the 21th century, accounting is finally moving beyond traditional methods toward automation. The goal of AI's auditing skills is to automate labor-intensive operation.

3.2 Current challenges: Large Data Volumes, Time-consuming Procedures, Human Errors

According to William Ross, Ashby's Law of Requisite variety: "The degree of control of a system is directly proportional to the information available about the system" (as cited in Naqvi, 2020). In the audit field, this means that the information and intelligence of the auditing entity should be at least as much advanced as the entity being audited. That's why it's mandatory for auditing companies to adopt higher technology than other businesses. The drawback of traditional auditing is its reliance on entering information manually, documentation on paper and ledger maintenance. That's way these procedures are not able to handle massive amounts of data efficiently. Whereas, AI-driven systems provide immediate analysis and accuracy of financial reporting. Thus, it enables better forecasting, fraud detection and risk assessment. At the same time, AI tools enhance audit process by improving forecast future developments and patterns and reducing human error. In this way, auditors can provide more complete picture of a company's financial health rather than the traditional approach. AI plays an important role also in terms of effectiveness and efficiency as nowadays auditors can easily analyze a huge amount of data without going into it. To take an example, the elimination of the double-entry accounting system will make the whole process quicker and more efficient. Moreover, the introduction of Robotic Process Automation (RPA) is another step forward in the accounting revolution. Through the automatisation of normal and repetitive operations, accountants are freeing up to work on more strategic operation, since manual collection of data is time-consuming and leads to inevitable human errors. According to Youyou et al., (2015) studies, AI-based judgements are more efficient than human ones. However, AI does not substitute the auditor work but instead can improve it, as auditors can concentrate on strategic decision making while AI can pursue data extraction tasks.

4. MINDBRIDGE AI-POWERED AUDIT PLATFORM

4.1 What is MindBridge AI auditor? Core Features and Technological Foundation

Traditional financial controls can no longer keep up with the volume and velocity of data changes by itself. The big data era introduced a revolutionary approach where there is the need to handling large amounts of information and to process data on a large scale, allowing organizations to anticipates trends, identify patterns and make reasoned decisions (Agustí and Orta-Pérez 2023). According to PwC (2022), many frauds go undetected because manual controls are too slow or incomplete. The evolution of advanced technologies has changed the way business systems are structured, with the integration of AI standing out as a transformative strength, particularly in the field of auditing. Audit plays an important role also in controlling the reliability of an organization's financial information. Currently, this scenario is facing complex challenges, highlighting the importance of safeguarding transparency and integrity (Wassie and Lakatos 2024).

As a result, AI stands out as a potential ally in terms of accountability and trustworthiness. The Big4 accounting firms- Ernst and Young (EY), Deloitte, PwC and KPMG- are at the forefront of adopting AI technologies enhancing efficiency and effectiveness. AI is clearly opening up new possibilities for a hybrid model, mixing together human and artificial work.

4.2 Mindbridge: Company Overview

Founded in 2015 in Ottawa, Canada, Mindbridge is a technological company, specialized in AIpowered financial risk discovery and anomaly detection in financial data. The company has developed an advanced platform, Mindbridge AI, designed to automate manual tasks and to perform real-time data analysis. Mindbridge's guiding principle:" Bridging the gap between human and artificial intelligence", underscores its mission to boost rather than replace human auditors. By delegating repetitive and labor-intensive tasks to AI, auditors are free to focus on more strategic activities.
As public attention on corporate financial practices intensifies, the need for tools that support transparency and compliance is growing. MindBridge AI stands out for maintaining regulatory compliance and transparency, supporting the detection and reduction of compliance risks and safeguarding the organization's reputation (MindBridge, n.d.).

4.3 How the Mindbridge AI Auditor Works

MindBridge AI approach is based on the simultaneously use of multiple techniques such as statistical models, machine learning and business rule.

- Statistical Models: The platform uses the comparison with expected models to detect irregularities. These methods rely on Benford's law and linear regression to highlight deviations that may indicate fraud or anomalies.
- Unsupervised Machine Learning: Leveraging anomaly detection algorithms, the system identifies changes in transaction amounts and shifts in activity volume. This technology is self-improving through data, becoming more accurate and precise over time.
- Users-Defined Business Rules: Organizations can configure domain-specific business rules that flag potential risks. These criteria are based on expert knowledge, helping to quickly identify data anomalies (MindBridge, n.d.).

4.4 Strengths of the Platform: Efficiency, Accuracy, Objectivity

MindBridge's AI platform uses cutting-edge algorithms that find patters in dataset without the need of supervision, with the aim of discovering unusual behaviors that a human could never find. MindBridge's platform offer several advantages supporting the audit process:

- Efficiency through Automation: The automation of routine tasks and streamlines processes reduces manual effort and time spent and allows professionals to focus on strategic work.

- Scalability and Speed: Scalable in processing hundreds of millions of rows, and so offering a broader risk coverage. The scale enables auditors to boost their productivity without proportionally increasing commitment.

- Objectivity and Transparency: MindBridge promotes transparency through explainable AI. Every decision made by the system can be traced and understood, which builds trust in its output.

- Data-Driven Insights: The platform is also able to analyze historical trends and relationships between different sets of financial data, helping auditors to better understand the context and interconnection of information (MindBridge, n.d.).

It is no coincidence the ongoing collaboration between Mindbridge and KPMG, highlighting firms' commitment to embracing innovative and advanced technologies to ensure transparency and integrity in their financial operations (Mitan, 2024).

4.5 Limitations

Despite all the advantages brought by AI in auditing, it is also crucial to analyze its current limitations. One of the most problematic dependencies is on the quality and completeness of data. Poor data quality can directly impact the success of any platform's output. The accuracy of AI's analysis is tied to the integrity of financial records fed into the system. Without access to sufficient or high-quality data, audits risk becoming symbolic. The old saying 'garbage in, garbage out', applies just as much to algorithmic auditing (Heck, 2024).

Another key limitation is tied to the interpretative nature of auditing itself. According to Raji, I. D., et al. (2020), automated auditing tools often lack contextual sensitivity, while human judgment remains necessary to assess intent and ethical appropriateness. PwC (2022) highlights that AI helps identify high-risk transactions, but auditors still need to exercise professional judgment when evaluating exceptions. AI can clearly play a crucial role in the auditing process, but there are some professional judgements of auditors that remains irreplaceable.

Furthermore, the use of AI in auditing introduces new ethical and legal questions around accountability. According to Santoni et al. (2023), without a clear and precise definition of accountability, it becomes difficult to say who is responsible when AI is wrong.

In conclusion, it goes without saying that MindBridge AI significantly enhance efficiency and accuracy as well as boost auditor's productivity. However, it is important to see it as a complementary tool rather than a replacement for human auditors. And, as the name suggests, it is a bridge between human and artificial work.

5. CONCLUSION

5.1 Summary of key findings

This thesis has explored how Artificial Intelligence (AI) is transforming step by step the auditing field. Thanks to key AI technologies, such as Machine Learning (ML), Natural Language Processing (NLP), Robotic Process Automation (RPA), Predictive Analysis (PA), and Anomaly Detection (AD), it goes without saying that AI is driving a huge shift in how audits are performed. Auditor's role, thanks to AI support, is more precise by benefiting from in-time and accurate entire dataset analysis. This results in increased efficiency, enhanced risk identification and improved overall quality. The use of AI, particularly through cutting-edge platforms like MindBridge, shows that the future of audit lies in a hybrid model that combines both AI computational power and human judgment (Deloitte, 2025). MindBridge, with its advanced features, including statistical modelling, unsupervised learning algorithms and customizable business rules, is the perfect example. Its use by firms such as KPMG, testifies the growing trust in AI-powered solution and highlights the importance of transparency and accountability.

Nevertheless, the adoption of AI also presents challenges. Data quality remains a critical factor since the effectiveness of AI is strictly tied to the quality and completeness of data. Furthermore, since auditing require interpretation and ethical evaluation, human judgement is still indispensable. These are the reasons why it is no possible to completely substitute human work. Even though according to Deloitte Global Gen Z and Millennial Survey (2025), 63% of Gen Zs and 65% of Millennials are

worried that it will be harder for young generations to enter the workforce as AI automates tasks typically performed by entry-level workers. However, AI is not a replacement for auditors but rather a powerful ally that boost their capabilities.

5.2 Future Outlook: More Intelligent Tools, Increasing Ethical and Regulatory Responsibilities

Looking ahead, further integration of AI in auditing is highly likely. Many companies have already seen encouraging returns on their early AI investments and they also expect to increase their overall spending in the next fiscal year (Deloitte, 2025b). They have had a notable improvement in detect fraud and manage risk, increase speed and encourage innovation and growth. However, there are still some sought benefits like improving efficiency and productivity and reducing costs.

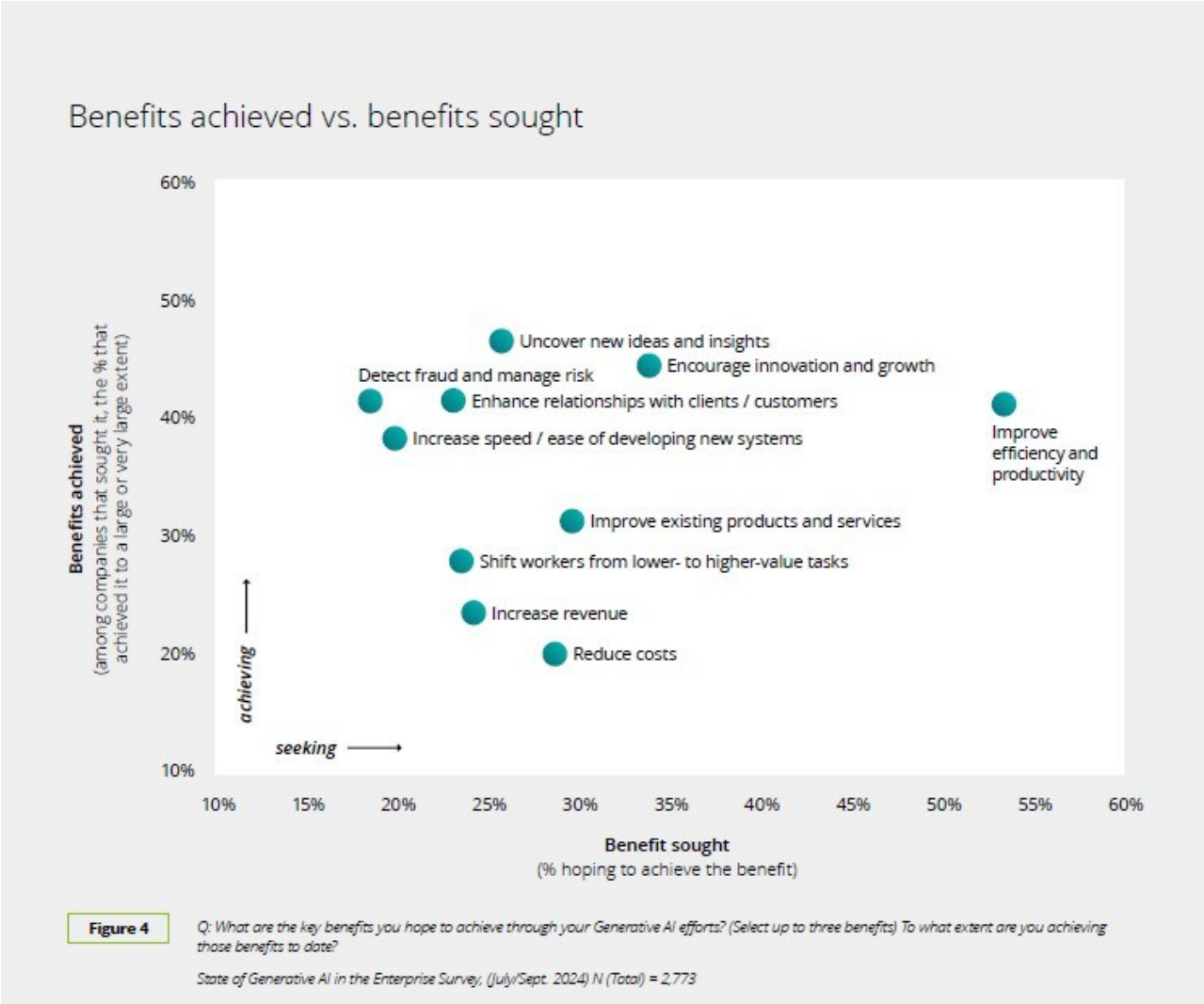


Figure 4 *Q: What are the key benefits you hope to achieve through your Generative AI efforts? (Select up to three benefits) To what extent are you achieving those benefits to date?*

State of Generative AI in the Enterprise Survey, (July/Sept. 2024) N (Total) = 2,773

Source: Deloitte. (2025b). *Now decide next: Generating a new future. Deloitte's state of generative AI in the enterprise. Quarter four report*. https://www2.deloitte.com/content/dam/Deloitte/us/Documents/consulting/us-state-of-gen-ai-q4.pdf

It is also mandatory to strengthen the ethical and regulatory framework surrounding AI. The European Union has established guidelines for Member States to apply ethical principles aligning financial digitalization with the Sustainable Development Goals of the 2030 Agenda (European Commission,

2019). It is essential to create common principles that prevent risks and regulate future financial operations.

Moreover, the role of the auditor itself is profoundly changing, moving from manual tasks to strategic oriented activities, even though, as shown in the graph above, real shift from lower to higher value tasks is still in progress. From now on, professionals will be required to interpret machine outputs, contextualize them and integrate them into a coherent analysis. Future auditors will have hybrid skills, combining technical-analytical abilities to analyze data with sound judgement to interpret it accurately.

5.3 Final Personal Reflection

Throughout the writing of this thesis, I have had the opportunity to explore how AI is profoundly transforming not only the audit process itself but also the auditor's role and how this job is perceived by external people. What truly impressed me is the essential role played by human judgement. Even though AI can process vast amounts of data and eliminate many human errors, the experience and critical thinking skills of a professional remain crucial for assessing the reliability of any data. Nevertheless, like it or not, from now on, human intelligence will no longer be alone, and as Naqvi said: "Embedding intelligence in machine is no ordinary change. It is one of the most extraordinary developments in the course of human history".

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