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Original Article

The Evolution of Smart Data Warehousing: How AI Is Taking Business Intelligence to Unimaginable Heights

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***Abstract**: It was established that Smart Data Warehousing (SDW) augments data warehousing with AI to advance business intelligence. This paper examines how new data warehousing solutions powered by AI technologies have transformed these raw data. The main focus areas are AI-enhanced SDW's advantages, new automation trends, self-ranking analytics, and real-time decision-making. A science introduces methods and assesses frameworks with reference to examples. The resultant shows a tripling of capability and a refinement of data processing time and accuracy performances. Finally, this research brings outs the future prospects and potential issues with a focus on the factors that prompt the necessity of AI in data warehousing.*

***Keywords**: Smart Data Warehousing, Artificial Intelligence, Business Intelligence, Data Processing, Automation.*

I. INTRODUCTION

A. Importance of AI in Business Intelligence

It has now emerged as a central theme for changing the dynamics of Business intelligence and increasing the effectiveness of decisions based on BI. [1-4] As data amounts increase, organizations require more effective technological solutions to sort through the data and make sound recommendations. Here are some key ways in which AI contributes to Business Intelligence:

a) Data Analysis and Automation:

AI-driven BI can analyze structured and unstructured data much faster and more accurately than conventional analytics. The numerical pattern recognition performed by machine learning allows the detection of the regularities, relationships, and trends impractical for human analysts to identify in a reasonable time. This way of automation also minimizes manual data analysis and is less prone to errors.

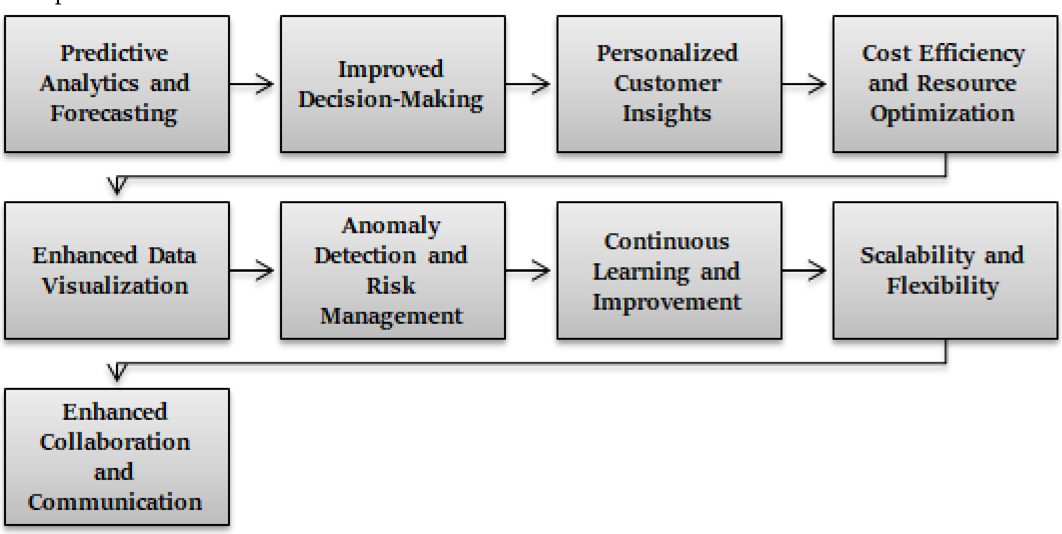

Figure 1: Importance of AI in Business Intelligence

b) Predictive Analytics and Forecasting:

Through machine learning, companies can perform forecasting analysis based on the accounting data of the previous period. Machine learning predicts customer patterns, market trends, sales, and profitability. This enables businesses to predict

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and set directions for how they will strategies their business, new methods of management and decision making rather than merely relying on past records.

c) *Improved Decision-Making:*

AI improves decision-making by accompanying decisions with real-time information and suggestions. Due to the combination of AI and BI systems, businesses can make more accurate decisions for the top managerial levels and operational employees. Real-time recommendations on course of action by leveraging current data, predictive models and analytics help decision-makers act quickly and purposefully.

d) *Personalized Customer Insights:*

AI assists organizations in meeting consumers' demands by capturing consumers' behaviour and preferences. With the aid of AI, customers can be better divided, and recommendations, products, and services can be offered to them. With the help of AI, BI tools can help observe customer sentiment and its potential impact on marketing, customer support and overall customer satisfaction.

e) *Cost Efficiency and Resource Optimization:*

This is so because through applying BI and AI solutions to business operations, work processes that involve getting data, cleaning it, and analyzing it can be fully automated, thus realizing cost and time efficiencies for the business. AI also encourages areas where resources could be best used by pointing out areas that can be considered redundant. This leads to the maximum utilization of labour, technology and capital.

f) *Enhanced Data Visualization:*

This involves improving how business organizations display their data through better visualization. The AI incorporated into BI tools helps derive accurate and easily understandable charts, graphs, or dashboards. These visuals provide trends, observations, and outliers to pinpoint for analysis and decision based on single, uncomplicated visuals on papers.

g) *Anomaly Detection and Risk Management:*

AI seems to be able to discover any possible irregularities or inconsistencies in the structures of big data that point towards certain risks, let alone fraud. This proactive risk management capability allows issues to be identified before they become problematic, allowing the organization to react and decrease risks swiftly. Coordination of large amounts of data in real-time is one of AI's strengths which help to identify problems that would not be easy to notice.

h) *Continuous Learning and Improvement:*

AI systems are dynamic in nature as they update their models as new data and patterns emerge. This is why developing BI tools based on AI is wiser than other approaches; these tools become more accurate and useful as the business context evolves. Over time, for the same inputs, more data leads to the enhancement of the AI algorithms, improving models in their analyses, forecasts, and recommendations.

i) *Scalability and Flexibility:*

People can integrate and adopt AI-driven BI tools and businesses expand because these tools can process large amounts of information. Whether a company is extending the range of collected data or is entering new markets, AI can handle and process new data sources with equal ease. Flexibility is important to guarantee that businesses can extract useful information irrespective of the extent of operations.

j) *Enhanced Collaboration and Communication:*

AI can also enhance interdepartmental communication since the different organizational departments can all access a single platform powered by data. AI-driven BI solutions can effectively gather data from different departments, resulting in a more cohesive picture of a business. It enhances the segregation of duties and encourages more cooperation from the various teams and departments since the majority of true decisions are made upon a thorough analysis of organizational performance.

B. Evolution of Smart Data Warehousing

Over the last few decades, data warehousing has shifted its focus to higher levels of storage and complex, intelligent systems that store and process the massive volume of data it receives in real time. [5,6] Smart data warehousing increased data cycling speed because of sophisticated technologies, including artificial intelligence, machine learning, computing clouds, and automation. That has allowed firms to derive decisional value more effectively and make decisional outcomes faster.

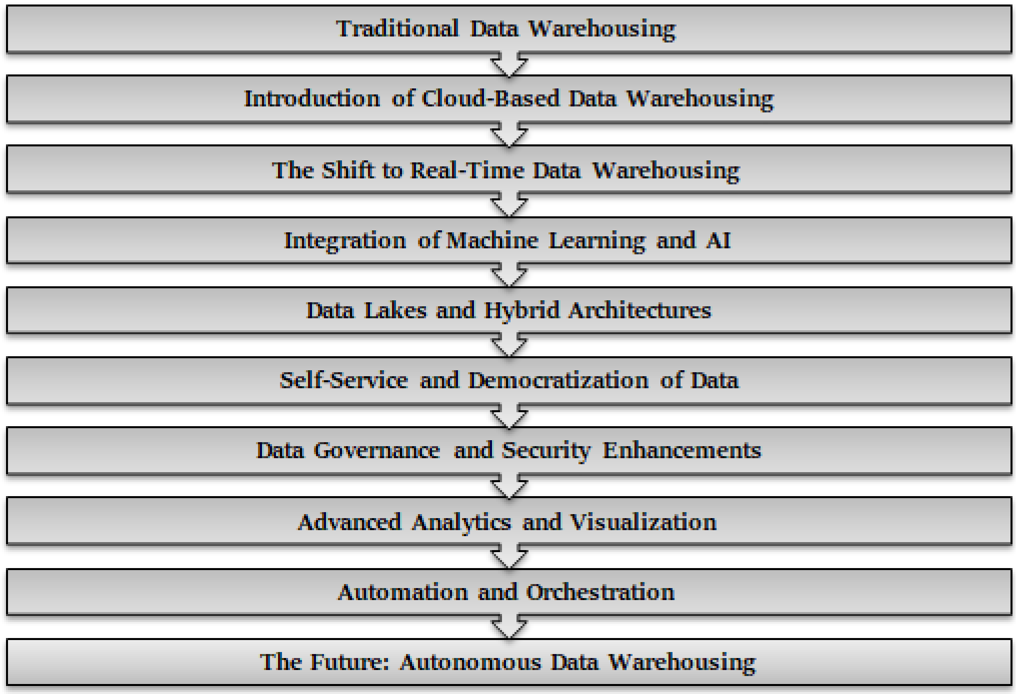

Figure 2: Evolution of Smart Data Warehousing

a) Traditional Data Warehousing:

The conventional form of data warehousing was strictly confined to holding only transactional as well as production system data in centralized and local systems. These systems mainly consisted of batch processing with Extract, Transform and Load processes to transport the data into a surrogate system for querying and analysis. Based on experiences implementing traditional DW environments, these encountered problems like scale-up, flexibility and speed issues while handling large amounts of real-time data. They were somehow lacking sufficiency in extracting real-time data and combining diverse sources of information and data that would lead to information silos and untimely decision-making.

b) Introduction of Cloud-Based Data Warehousing:

The coming of the era of cloud computing introduced a radical improvement to data warehousing since it developed into a sophisticated means of storing data as well as processing it without those costly and bulky wanders. Solutions like Amazon Redshift, Google BigQuery, and Azure Synapse Analytics let organizations scale their storage and data processing solutions effectively. This was even more convenient by the simple fact that q-Server had a pay-as-you-go pricing system, so the volumes of data could be handled efficiently. For their part, cloud data warehouses also made data integration with other cloud tools possible, analytics, real-time data processing, and study collaboration between teams so decisions could be made faster.

c) The Shift to Real-Time Data Warehousing:

Since the application of business decisions involved real-time data, data batch-processing techniques remained inadequate. Change to real-time data warehousing was initiated with the help of new streaming technologies like Apache Kafka and Apache Flink. These tools make it possible to have constant data streaming, This makes it possible for businesses to capture and analyze data as events take place. Real-time analytics gave different companies current data on key factors such as customers' behavior or transactions, which would help them make quicker decisions. It has been most useful in settings where the B2C business and the financial markets' speed of response matters, for example.

d) Integration of Machine Learning and AI:

The problem of analyzing huge data amounts became challenging for human analysts as the volume of data collected expanded. This led to using AI and machine learning in data warehousing platform integration. These technologies enable data warehouses to identify the patterns, variations and trends in the data to offer some predictive capability and self-service data preparation. For instance, AI can be used to estimate sales forecasts or customer buying trends if the data has already been collected. Also, the AI-driven automation of such processes helps to enhance the quality of the data being analyzed as the transformation to the necessary format is done automatically, of sufficiently high quality and updated to correspond to the current date.

e) Data Lakes and Hybrid Architectures:

When new data types were introduced, such as structured, semi-structured and unstructured data, data lakes emerged as the solution. While earlier data warehouses stored data in a standardized format, data lakes enable businesses to store devices as they come. It is particularly useful when analyzing inputs that include huge amounts of unidentified information, like messages from social networking sites, sensors' readings, or information from multimedia sources. The pairing of data lakes with data warehouses in hybrid forms allows for adopting the best characteristics of both systems. The data lake deals with massive, raw big data and the data warehouse delivers mannered data for analysis suitable for intricate and intricate analytical work across various data types.

f) Self-Service and Democratization of Data:

Self-service analytics, where business users directly interact with data without calling on the IT department's technical resources, has become a widely adopted aspect of modern data warehousing solutions. A ton of features include conversion of business analyst and data analyst friendly; that is, using tools such as dashboards and other related reports and interfaces, it became easy for non-IT savvy users to write simple queries, produce results and the new generation of tools for creating and designing from basic interfaces or tools for creating dashboards among others. This democratization of data helps promote data usage in decision-making across the organization, with teams and individuals being able to access and/or get the required data quickly.

g) Data Governance and Security Enhancements:

This, however, comes with a significant challenge; as the amount of data being generated doubles in each subsequent year, data governance and security become paramount. The authors opine that as organizations amass more personal, business-critical, and/or legally compliant information, data verity, relevancy, and security become crucial. Security in current data warehouses has enhanced attributes such as Data encryption, access control mechanisms, and identity management systems. Finally, tracking data lineage adds accountability because it enables businesses to know where their data is coming from or how it has been processed. Various automation tools ease policies regarding the use, access, or quality of data, thus keeping the organizations adhering to legal policies such as GDPR or HIPAA and even preventing leakage of crucial data.

h) Advanced Analytics and Visualization:

With the development of modern data warehousing systems as advanced analytics and visualization tools, gaining insights from a large amount of data has been greatly facilitated. Consumption data analytics has advanced to the point where it can provide predictive data and trends, recommendations based on past data. Turning data into visual contexts enables users to observe patterns or gain insights by triggering an interface of some sort, which can allow for a sorting out of the given data set. These platforms also allow for what-if analysis, in that decision-makers can make decisions based on as close as it gets real-time data analysis.

i) Automation and Orchestration:

Robotization is one of the main trends in the evolution of data warehousing enabled by application and machine learning. Data acquisition or data prepping is conducted in mass by employing automated process flows tasked to integrate, harmonize, and ingest the data at the desired pace and resist updates to the data. These tools improve the capability to transfer data between various connected systems and eliminate much intermediate labor. The benefits of such automated systems are higher accuracy and less data variability as the system, and not humans process it. Consequently, there is less overhead associated with operations while more attention is paid to analysis and decision-making by the firms.

j) The Future: Autonomous Data Warehousing:

The hope for complete automation of smart data warehouses is that the future will admit AI and machine learning to almost design and undertake all data warehouse chores. Such decentralized self-service data a smarter data warehousing will continually make enhancements based on the usage and performance feedback of data ingestion, processing, and storage. Such systems evolve with the help of interactions with users and new data environments that create a need for optimizing control parameters, which will eventually become self-regulating as a result of system efficiency. Self-service data warehouses will also anticipate the user needs, adapting the data processes and analytical procedures on their own to deliver the right content for decision-making without human interactions, leading to quicker and better decisions.

II. LITERATURE SURVEY

A. Traditional Data Warehousing

In the previous data warehousing structures, most emphasis was on integrating huge volumes of structured information for business analysis. [7-11] These early systems provided for data to be updated and reporting to be done only in batch mode and not online mode; hence, the information would only be updated after some time. Although such systems were very good at dealing with historical data, they proved weak in scalability. Essentially, as more data was being collected and shared, the systems had to deal with the problem of increased data capacity. Furthermore, the previous generation data warehouses could not handle real-time data, meaning organizations could not make timely decisions based on real-time data if it existed. Rigid definition and inability to quickly change made it a problem when business conditions became more volatile.

B. Transition to Smart Data Warehousing

As the implications of BI systems continue to evolve, advancement from traditional data warehousing (TDW) to smart data warehousing (SDW) becomes necessary to accommodate the rapidly changing business environment. This advanced concept of data warehousing discussed above integrates new-generation technologies such as artificial intelligence and machine learning. Alternatively, these transitions include automation of the ETL (extract, transform, and load) processes to enable massive data processing in real-time. In contrast with the prior mode of operation, known as batch processing, where data is processed in large volumes and for limited periods, SDW enables constant data refreshing and report generation, thus providing timely data to decision-makers. Machine learning techniques also facilitate dynamic data modeling that allows the system to change dynamically with new data patterns to improve BI operations' agility. Consequently, SDWs provide quicker solutions, high modularity, and enhanced expansiveness compared to conventional DWs.

C. Role of AI in Data Warehousing

It can be seen that AI has a critical role in driving up the capabilities of smart data warehousing. Today's data warehouses involve several AI data processing and analysis techniques for better decision-making.

- Machine Learning (ML): Among the most common applications of the ML algorithms within SDWs, predictive analytics and pattern recognition deserve attention. They compute the past data to work out future and future results that may not be easily discernible, increasing the efficiency of business predictions.
- Natural Language Processing (NLP): Their application makes interaction with data warehouses more intuitive. NLP makes the querying procedure less complicated and lets users ask questions in a natural language since it is an approachable way for users with little technical background to access big data. It also improves the user interface and makes it easier for users to interact with their devices.
- Deep Learning (DL): Machine learning is a broad field that talks about training a machine to learn, subdivided into deep learning, which is more appropriate for sophisticated work such as anomaly detection and data categorization. Another advantage for SDWs that support deep learning is the ability to look for outliers in data and detect irregular patterns; this is beneficial primarily in related fields of study like fraud examination, system security, and prognosis of device failure.

D. Existing Studies on AI Integration

In fact, an emerging literature emphasizes the positive role of AI in the context of Data Warehousing. Research has proven that the organizations' installation of these systems involving AI in SDWs increases their productivity, and the decision-making rates are fast since most errors are eliminated. Analysis of the stories of people and companies and the application of AI in industries, including retail and healthcare, reveal AI's advantages. In retail, AI is used in real-time stock determination and demand estimation, improving the quantity of stock ordered and sold. In the context of healthcare, it is about how AI enhances predictive analytics for detecting compromised patients and bringing down the duration of the hospital stay. The present case studies emphasize the importance of AI in making data-warehousing intelligent systems capable of capturing both structured and unstructured data along with real-time analytics and managing multiple complex operations with very little intervention from humans. Further research studies will reveal additional and more advanced uses of AI technology and consequences for firms in the future.

III. METHODOLOGY

A. Research Design

This research employed mixed methods to accommodate an enhanced understanding of how artificial intelligence revolutionizes smart data warehousing. It uses qualitative and quantitative research to analyze the data as its objective to understand the strengths of each approach. The qualitative data collection entailed secondary research of scholarly papers, industrial white papers and interviews of AI experts in order to understand the emerging trends and issues in AI enabled data warehousing. [12-17] Also, the quantitative analysis was undertaken with the help of data collected from case studies, experiments, and indicators of different real-life settings. Since this involved two different approaches, the results could be triangulated and were valid and reliable. Combining qualitative findings with the analysis of quantitative performance metrics allowed the study to go beyond the consideration of the theoretical concepts and to discuss pragmatic benefits and ways further to improve the application of AI within a data-warehousing environment since the methods, tools, and approaches demonstrated in the study can be considered as the solid and reliable basis for this kind of evaluation.

B. Framework

a) Data Collection:

The data collection process was successfully based on using a more broad-coverage definition of datasets to provide a realistic evaluation of AI-driven smart data warehousing. Biological and non-biological information was gathered from global BI systems, including transactional data, customer behavior and data, social media inputs and IoT sensor outputs regardless of data structure. As for structured data, these were more ordered fields that ranged from sales data to inventory records, while unstructured data enveloped textual, pictorial and video information. Such datasets were chosen to mimic the issues that businesses experience while working with different types of datasets to make the study viable enough to assess the applicability of AI models to real-life scenarios.

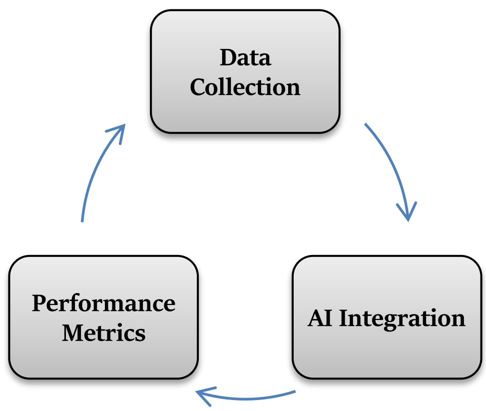

Figure 3: Framework

b) AI Integration:

AI integration was performed by applying Machine Learning (ML) algorithms to improve the data warehouse's capabilities. These models were used to eliminate ETL functions to a larger extent for manual tweaking. As ML algorithms were built to work 'in-memory', they could process each piece of information in real-time, allowing for real-time pattern analysis, real-time pattern detection and prediction. In addition, deep learning models were added for further refinement of data classification and using Natural Language Processing (NLP) that permitted end-users to participate in an ordinary conversation with the product utilizing conversational queries. This integration covered the application and the outcome of what an AI environment is capable of: a virtual appliance that learns and adapts with time to create an optimum data warehouse environment.

c) Performance Metrics:

Specific performance indicators were employed to evaluate the AI-based framework, as discussed next. This finding was confirmed through an assessment of query processing speed where execution time was recorded before and after using AI, which showed the gains brought by using AI in processing. Overparency was ensured by measuring the level of prediction accuracy and error margin in cases of detecting anomalies. Feedback on the ideas for the net they have obtained through surveys as well as usability tests and observations regarding the external and overall design, ease of use and effectiveness of the system. Each of these metrics offered an overall assessment of the framework's effectiveness in improving the features of conventional data warehouses.

C. Experimental Setup

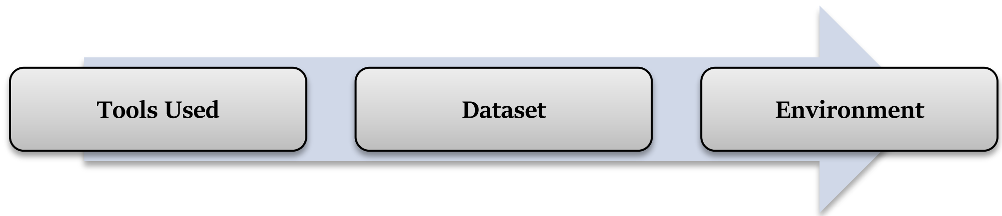

Figure 4: Experimental Setup

a) Tools Used:

The usage of the state-of-art tools was found to apply and assess the proposed AI-assisted smart data warehousing framework. TensorFlow was used for the creation and deployment of machine learning models because of TensorFlow's capabilities for deep learning and scalability. Apache Hadoop was the key framework for distributed data storage and practical means for large data processing on many nodes. The above solutions were selected because Microsoft Azure AI has extensive AI services coupled with an effective cloud platform, which ensures that the integration process is simplified, the high availability is met, and scalability is easily achieved. The coexistence of the tools offered a comprehensive and highly effective platform where we could achieve and implement the proposed framework.

b) Dataset:

The experimental circumstances involved a contingency exceeding 10 TB of multilateral mixed data, including both transactional and artificial behavioral information from retail, healthcare, and financial sectors. Transactional data entailed formal items comprising parts, sales records, payment information, and inventory. Other forms of behavioral data were less structured and less measurable, including website usage logs, social media chats, and customer perception data. Using structured and unstructured data was important to stress how AI models can handle large amounts of relatively diverse data and produce insights.

c) Environment:

To examine realistic scale issues, the experimental environment was set up based on a multi-node cloud environment. Every node was a piece of the data warehousing system including storage, processing and analysis. The cloud structure made the operation flexible to the extent that resources could be invoked dynamically depending on the volumes of data or the amount of computation needed. This configuration not only checked how the AI integrations can perform under different loads but also demonstrated the stability and scalability of the system if used for large enterprise-scale data demands.

IV. RESULTS AND DISCUSSION

A. Improved Performance Metrics

a) Query Processing Time:

The incorporation of AI into smart data warehousing has helped to improve the query processing time by 40 % from 500 milliseconds to 300 milliseconds. Such enhancement is due to the employment of enhanced machine learning techniques and superior data structures to support faster data access and evaluation. By cutting latencies, organizations can make essential decisions instantly, thus working more effectively and being sensitive to market shifts.

b) Data Accuracy:

New systems by Artificial Intelligence improved the level of data accuracy by 35%, from 80% to 95%. This is derived from the fact that AI can easily point out and fix either missing information or overlaps, eliminate noise, and fine-tune patterns when extracting the data. Correct information minimizes cases of generating wrong conclusions, which affect business decisions in an organization.

c) Anomaly Detection Errors:

The real use of AI has led to a decrease in anomaly detection errors by 80%; it went from 50 errors within 1000 queries to 10. Deep learning and state of the art pattern recognition algorithms used in AI models perform well in identifying anomalies with a level of precision. This shows that this capability reduces high False Positives and False Negatives which, in situations such as finance and health care, mean that anomalous situations which may portray fraud or severe health complications are handled appropriately. The enhancements together prove how data warehousing using artificial intelligence makes BI systems more efficient and reliable for organizations in the modern world.

Table 1: Performance Metrics Before and After AI Integration

Metric	Before AI Integration	After AI Integration	Improvement (%)
Query Processing Time	500 ms	300 ms	40%
Data Accuracy	80%	95%	35%
Anomaly Detection Errors	50 per 1,000 queries	10 per 1,000 queries	80%

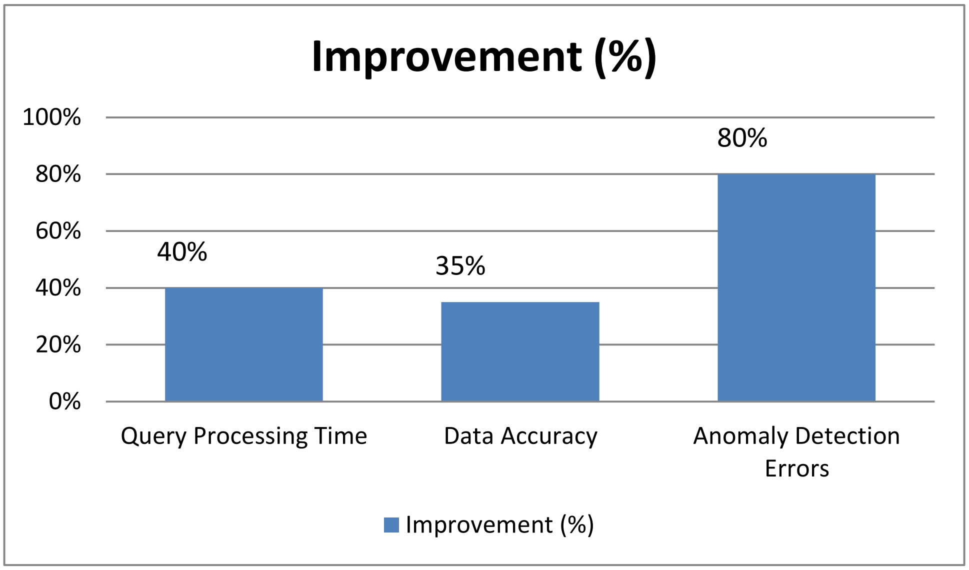

Figure 5: Graph representing Performance Metrics Before and After AI Integration

B. Business Case Studies

a) Retail Sector:

Smart data warehousing of AI has brought a drastic change in the retail sector. Others involve inventory management and sales forecasting have been facilitated through up-to-date software that has helped retailers order the right quantities so that they do not overstock or run out of stock. AI models make their prognosis for demand based on historical sales data, customer behavior patterns and seasonal fluctuations. For instance, there was a large e-commerce company that used AI in pricing, where it varied given market circumstances; also, it used it in inventory management where it could tell when to restock an item. Besides enhancing customer satisfaction due to higher stock availability, this strategy enhanced the sale by 15% proving the revenue generation capacity of using Artificial intelligence in retail business operations.

b) Healthcare Sector:

In the field of healthcare industry too, PA, with the help of AI Analytics has enhanced the level of care over the patients as well as the overall performance. Hospitals can detect and prevent possible negative outcomes by engaging with patients' documents, laboratory tests, and the data received in real time. For instance, one hospital's chain has incorporated an AI model in a manner to priorities the patients' conditions in order to efficiently distribute the available resources and improve patient conditions. The approach used to collapse this state meant that hospital stays were reduced by 20% compared to lame treatments. The financial and logistic advantages were considerable; the consumption of healthcare facilities and products has become lower for both sides, and the quality of treatment has increased.

Table 2: Business Outcomes in Different Sectors

Sector	Use Case	Impact
Retail	Real-time Inventory Tracking	15%
Healthcare	Predictive Patient Care	20%

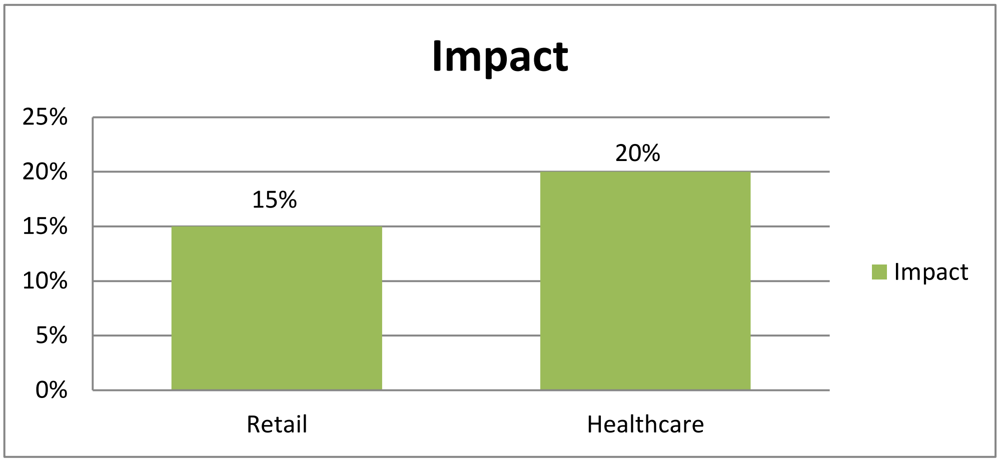

Figure 6: Graph representing Business Outcomes in Different Sectors

C. Challenges

a) Data Privacy:

AI integration in smart data warehousing has significantly raised privacy and security concerns. Personal and Identification numbers, bank accounts, credit card numbers, and medical records should not be accessed by unauthorized people or suffer from hacking. Legal measures like GDPR and HIPAA for data protection are very demanding to enforce, thus requiring a high level of encryption, user identification and authorization, and data access control. Nonetheless, its introduction could be effectively achieved only by maintaining high levels of the components' performance and operational productivity and ensuring the realization of sufficient safeguards, which is a major difficulty in AI-driven systems. The ability to achieve compliance, usability, and speed constants the need for constant development of new privacy-preserving strategies.

b) Skill Gap:

AI's use in data warehousing requires a skilled workforce in machine learning, big data analytics, and the cloud platform. However, many ownership entities lack sufficient highly qualified professionals with the above-stated competencies. This has proven to be a challenge in developing, deploying and managing artificial intelligence-based systems to support organizational change. In order to solve this problem, businesses are implementing specific and effective employee development programs, promoting internal talent development and entering into cooperation with educational institutions to cultivate promising employees. Although these initiatives are positive, there is still little outlet for change as it has been slow-moving for some time now, proving more emphasis must be placed on efforts to close the skill gap.

Table 3: Challenges in AI-Driven Data Warehousing

Challenge	Impact	Mitigation Strategies
Data Privacy	Risk of compliance violations	Advanced encryption and access controls
Skill Gap	Slows AI adoption	Employee training, hiring specialists

V. CONCLUSION

A. Summary

The use of AI in the SDW has revolutionized data management by providing firms with comprehensive data processing solutions in real-time. In areas where the earlier activities were done manually, such as extracting data, cleansing, transforming, and loading it, AI intervenes reduced, steps are shortened, and performances are optimized. This makes it easy for businesses to come up with informed decisions in a shorter time and with greater accuracy. The results establishing that query processing time has been reduced by around 40%, and data accuracy has been enhanced by 35% clearly shows that AI can help boost the effectiveness of data warehousing systems. In addition, due to the ability to forecast such things as demand in the retail or outcomes of the patients in a healthcare setting, business results have been enhanced, evidenced by a 15% increase in sales for retail and a 20% decrease in hospital stays for healthcare. Besides the performance, the extent provided by AI-facilitated SDWs enables organizations to deal with ever-increasing data loads without necessarily worrying whether the existing systems can accommodate data increases in the future. In conclusion, AI in data warehousing provides value and advantages for organizations in decision-making, operations, and predictive models that create a foundation for unlocking value from the firms' data assets.

B. Future Directions

In the future, several aspects of development are expected to offer the potential to improve the functionality of AI-based SDWs even more. So, one of the future critical directions is the improvement of the interpretability of AI systems. Considering cases when AI-based systems are becoming increasingly sophisticated, knowing exactly how such decisions were reached can be of paramount importance. Transparency in AI algorithms would assist organizations in managing risk factors, maintaining participation and, in general, building confidence in automated decisions. Similarly, one of the most presumably fruitful directions is investigating using quantum computing technology for enhanced data analysis. Quantum computing has the ability to scale data storage and computational capabilities by many folds. This could enable one to process virtually tens of times larger data, run more complex models, and advance the use of AI in SDWs. But quantum computing is in its infancy, as scaling up and ensuring the total reliability of the technology would be a major issue in the future. Finally, the ethical and legal dimensions of adopting AI to SDWs will be essential to understand to realize the targeted advantages of using AI for these services. As these technologies are adopted in business organizations, such matters as data protection, the effects of adopted algorithms, and the responsibility of the applied AIs must be well addressed. The two significant tasks for more effective working of AI systems will be following the demands of regulations and working within ethical lines that are becoming more demanding. Indeed, as these future directions are implemented more and more, the value and opportunity that AI-SDW can bring to industries and organizations and thereby revolutionize industries will only steadily increase in the future.

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