

# Next - Gen BI: Leveraging AI for Competitive Advantage

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**Abstract:** *Business Intelligence (BI) has, for most of the past, served to prepare organizations to make business decisions based on information. AI powers the BI today and has gone a step further to provide predictions about the business environment. This paper sought to discuss the use of AI in BI with a focus on the realization of competitive advantages. Therefore, it presents the current literature on AI - intensive BI, the procedural framework for deploying AI in BI systems, the results, and the implications for businesses. This paper uses BI case studies and research data to illustrate the radical change that AI brings to BI and offers a conceptual map to help organizations that aim to employ AI for decision - making.*

**Keywords:** Business Intelligence (BI), Artificial Intelligence (AI), Machine Learning (ML), Predictive Analytics, Competitive Advantage, Data - Driven Decision Making

## 1. Introduction

BI has evolved, especially in recent times, due to what we call Artificial Intelligence (AI). It has also been found that the conventional BI applications are mainly of descriptive and static nature with currently a shift to build predictive and prescriptive models with AI integration. [1, 2] This integration is very important, especially for business organizations that would want to remain relevant in the ever - emerging market forces which are significantly oriented towards data management and utilization.

BI systems have been as essential in the operations of organizations as they provide solutions for the collection, analysis and modification of information for business strategies. However, one must understand that the contemporary approaches to working with data are insufficient for BI tools to solve the issue. Business intelligence as an integrated concept is complemented here by AI: while the first one deals with the processing of huge sets of information, the identification of potential patterns, or learning from data, AI adds value to BI systems.

### 1.1. The Evolution of Business Intelligence

BI is considered as originated in the early 1960s as Decision Support Systems (DSS), which aimed at helping business managers in the decision - making processes using available information. [3] In recent decades, BI FF has progressed through several evolutions, adopting multiple technologies to enrich it.

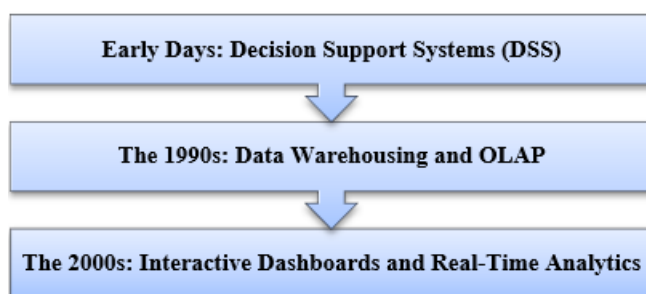


Figure 1: Evolution of Business Intelligence

### 1.1.1. Early Days: Decision Support Systems (DSS)

The first stage of BI, which was DSS aimed at presenting managers with information that is gathered from different sources to back up managerial decisions. These systems were pre - historic; it was common for one to enter vast amounts of data into the system manually and was mainly concerned with day - to - day decision - making as opposed to strategic decision - making.

### 1.1.2. The 1990s: Data Warehousing and OLAP

In the early 1990s, more developments in BI were observed with the electronic inventions of data warehouses and Online Analytical Processing (OLAP). Ahead of its time data warehousing means integration of data acquired from various sources in one location; convenient to store, retrieve and analyze. With the help of OLAP, multidimensional analysis became possible, by means of which users were offered the tools to perform query services and examine the information from different angles. It opened the era of operational to strategic BI, which means organizations are not only restricted to the analysis of facts and figures but it also allows the organization to foresee the facts and figures of the future.

### 1.1.3. The 2000s: Interactive Dashboards and Real - Time Analytics

The new millennium saw the bi systems incorporating interactive dashboards and real - time analytics into business intelligence. Well - designed dashboards enabled users to establish appealing graphic user interfaces with KPIs and metrics read - only, ensuring that data was easier to navigate and comprehend. Real - time analytics were the processing and analyzing of data as soon as the data was created, which meant that business decisions could be made faster.

## 1.2. The Role of AI in Modern BI

The proliferation of large volumes of data at unparalleled speeds and in diverse forms, which is commonly described by the three Vs of Big Data, has presented some major problems to BI solutions. [4] As these are developed initially for historical data, they cannot cope with the need for modern data systems. The introduction of AI as part of BI solutions can be seen as a major step in the evolution of BI

that helps to overcome these difficulties and add new possibilities.

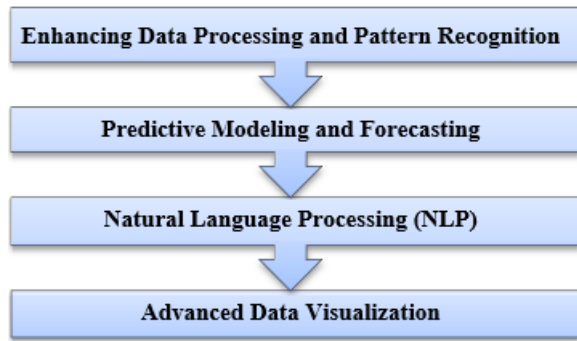


Figure 2: Role of AI in Modern BI

### 1.2.1. Enhancing Data Processing and Pattern Recognition

Therefore, it can be said that AI helps in enhancing BI because it optimizes and speeds up data analysis. The application of AI, particularly machine learning as an element, can process terabytes of data in a far shorter period and with high accuracy when compared to conventional methods. These algorithms are able to distinguish patterns and anomalies that perhaps a human will not be able to identify in data.

### 1.2.2. Predictive Modeling and Forecasting

The greatest asset of AI to BI is the capability to implement predictive modeling. The information acquired in machine learning enables models to probe into the past records and point out the converted data which may be useful to predict future results. This capability shifts BI from a tactical tool that deals with what has happened to a strategic tool that can give insight into what is about to happen. These prediction results are useful to businesses by providing better information, managing resources effectively, and preventing changes in the market.

### 1.2.3. Natural Language Processing (NLP)

Natural Language Processing (NLP) is yet another branch of Artificial Intelligence that greatly affects BI. NLP extends the BI system's capabilities in the ability to comprehend and analyze natural language and as a result, the systems can process text data from social media, emails or reviews. This enables the business to get a view of the customer's sentiments and feedback from more diverse data sources in real - time.

### 1.2.4. Advanced Data Visualization

AI - driven BI systems are also able to incorporate sophisticated methods of data visualization. These techniques employ the advancements in AI tools to create even more complex and dynamic graphics that allow the users to analyze complex data better and consequently arrive at the right decisions.

## 1.3 Importance of Next - Gen BI: Leveraging AI for Competitive Advantage



Figure 3: Importance of Next - Gen BI: Leveraging AI for Competitive Advantage

### 1.3.1. Data Handling and Analysis

- **Real - Time Data Processing:** Computerized BI systems can analyze data in real time, hence making it easier for businesses to respond to tricky situations in the market or other issues affecting operations. Real - time analytics reveals information in real - time, which means decision - making can be informed by real - time information.
- **Better Data Completeness and Reliability:** Even data cleaning can be made automatic through AI algorithms so that the data to be analyzed is clean and valid. This minimizes the errors that are usually associated with the manual handling of data and improves the quality of information obtained.

### 1.3.2. P&PE (Predictive and Prescriptive Analytics)

- **Predictive Analytics:** AI incorporates predictive systems whereby business owners are capable of predicting future events and the possible consequences that may be likely to occur by basing such predictions on known occurrences. This capability enables organizations to prepare for some of the changes to occur in the customers' behavior or the marketplace or identify the need for some changes in its operations.
- **Prescriptive Analytics:** Not only does it entail the ability to predict the occurrence of events in the future, but AI is also capable of giving prescriptions for appropriate actions. It is of great benefit to businesses because apart from telling them what can happen, it also tells them what course of action is taken.

### 1.3.3. Enhanced Decision - Making Capabilities

- **Data - Driven Decisions:** AI appears to strengthen BI because the former provides a better understanding of the analyzed data. This reduces the probability of the decision - makers relying on guesswork or, in some other cases, inadequate information when formulating their strategies.
- **Scenario Analysis and Simulation:** Various business situations are capable of being mimicked by incorporated AI BI systems in which the organizations can foresee the probable outcomes and adopt the right strategic direction. Therefore, this capability is very useful in aspects of risk management and formulation of strategies in the organization.

### 1.3.4. Automation and Efficiency

- **Automating Routine Tasks:** Machine intelligence can help organizations perform tasks that are tiring, time-consuming, and may bog employees down; thus, employees can be redeployed in other areas. They enhance the cycle time and simultaneously reduce the costs and, at the same time guarantee that the employees will attend strategic activities.
- **Intelligent Reporting:** AI features coupled with BI means that it is possible to have analysis reports that contain relevant information pointers as well as trends generated independently. This saves time that would have been used in the preparation of reports and also ensures that the right information gets to the decision-makers on time.

### 1.3.5. Personalization and Customer Insights

- **Personalized Customer Experiences:** Customers' large datasets can be processed by AI to deliver relevant solutions related to their needs, which will promote customer satisfaction and trust. Based on all these aspects above, people's preferences and behavior may help businesses to better market their products.
- **Enhanced Customer Segmentation:** AI means that customer segmentation can be improved and businesses can find the desired customer groups and use marketing strategies to precisely target these groups. This results in increased efficiency in targeting the consumers as well as efficient utilization of the resources.

### 1.3.6. Competitive Advantage

One of the critical guidelines that need to be followed in the process of managing an organization is the need to stay ahead of the competition. The application of AI in BI thus provides a strong competitiveness for any business. The analysis of the data and recommendations provided by AI help organizations to generate new ideas about doing business, become more efficient and adapt to the new conditions.

### 1.3.7. Innovation and Growth

BI, with the help of Artificial Intelligence, enhances creativity since it reveals patterns that were not visible before. This fosters the growth of the business and can ensure organizations adapt to new changes in the market.

## 2. Literature Survey

### 2.1. Machine Learning in BI:

Another area in which BI has been made better through the utilization of machine learning is by providing predicting analytical tools. Therefore, by applying the different algorithms from Machine Learning to the historical data of business activity, businesses can be more accurate in their prognosis of future tendencies and activity. For instance, in retailing, the ML models can be taught to solve the sales history from factors such as weather or any other form of economic data to come up with the consumers' demand. Thus, with such a predictive capability, it becomes easy to manage the inventory stock, anticipate trends in the market, and even design promotions based on the given customer profile. Lastly, the utilization of ML in the BI results in

converting data into an active tool from being an organization's accumulated stock, which catalyzes the competitive environment for businesses.

### 2.2 Natural Language Processing in BI:

NLP is a key component in BI because it assists with the analysis of text contained in various items, including customer feedback, social media, and emails. Namely, NLP algorithms can extract the sentiment, topic, and trend from a huge stream of text; hence, the businesses will receive great value in the form of customer opinions and market insights. [5] For instance, a retailing firm can use NLP to analyze consumers' perception of their goods and the trends of activities in the market and attend to it by either improving their products or services from the perspective of clients' opinions in their stream. Hence, by integrating the NLP into the BI, organizations were in a position to enhance the relations with the customers, enhance the flow of operations and gain a competitive advantage in analyzing the dynamically shifting market.

### 2.3 Computer Vision in BI:

Mobile BI employs features such as computer vision that caused radical changes in such fields as manufacturing and retailing by expanding the ability of BI systems to interpret graphical data from images or videos. In manufacturing, the installation of computer vision can check on quality of manufactured items, check for flaws during manufacturing, and ensure that they have met some set manufacturing characteristics. In retailing applications, computer vision technologies can learn the structure and spatial arrangement of a store and the pointing direction of customers and on the basis of the images of the environment; it can decide how the shelves should be arranged. By incorporating computer vision into BI services, the enhancement of the BI companies' services and products has been highlighted through the enhancement of operational efficiency, the improvement of the decision-making processes, and noted customer satisfaction due to the analysis of the identified data from the visual data.

### Case Studies of AI - Driven BI:

- **Retail Example:** A series of stores that became famous wanted to integrate artificial intelligence and business intelligence systems in the analyses of the customer's buying behavior by means of machine learning. By integrating yearly sales data of the company, demographic information, together with overall tendencies of the consumers' purchasing behavior, the company under analysis would be capable of predicting the consumption rate with respect to some specific items. This enabled them to order the right quantities of stocks in their stores to avoid a situation where the stores ran out of stock and also to make deployment of certain promotions for some segments. Hence, it tilted the rate of per-capita sales and customer satisfaction level positively because the traffic flow is congregated well with their need and buying propensity.
- **Healthcare Example:** especially in the field of healthcare, NLP can also be useful in aiding in the transformation of the EHRs into useful data. When the

statistical structure is based on NLP techniques the trends of diagnosis, outcome of treatments, as well as various attributes of patients can be identified. Any such enhanced knowledge, thereby, assists the hospitals to properly distribute resources, map out the individual patient's treatment plan, and even refining the treatment recommendations. For example, with historical data analyzed using NLP, organizations in the healthcare sector that want to bring a positive change in people's lives can plan which patients are likely to consume most of their resources in the upcoming period and form strategies for their work accordingly, sort out potential time - consuming administrative issues regarding patient management and improve the overall patient satisfaction levels as the historical analysis of the administration of healthcare organizations would suggest.

### 3. Methodology

#### 3.1 Framework for Integrating AI into BI

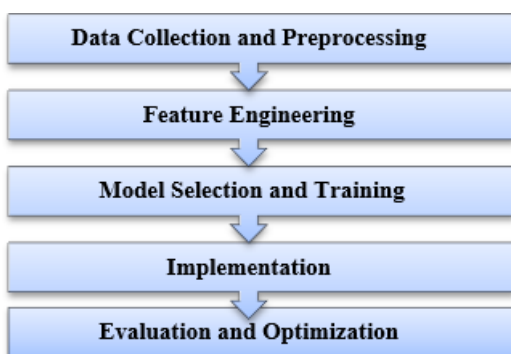


Figure 4: Framework for Integrating AI into BI

##### 3.1.1. Data Collection and Preprocessing

- **Confidentiality and Privacy:** Make sure collected data from different sources, databases of the company and servers of other providers must be anonymized to provide the confidentiality of the individuals. Ensure good levels of data encryption and data access control to protect data during data collection and data preprocessing. [6] Follow the standards like GDPR to make sure that data privacy is respected during the process.
- **Informed Consent:** Recorded consent is required in the research, and the participants' consent should be sought on the use of their data in the research, and the potential benefits of the research are to be explained. Assure participants and patients their rights, like withdrawal of consent from participation at any time in the future, are protected.

##### 3.1.2. Feature Engineering

- **Bias Mitigation:** Consult the field knowledge in order to reduce the chances of having features that have a predisposed inclination towards bias when using the following: Periodically examine the feature selection with the help of audits and reviews in order to prevent the influence of biases.
- **Transparency:** This requirement is easily explained as a guideline to show how the various feature engineering steps are done in order to enhance the model's performance. Realize that it is important to inform the

stakeholders about the reasons behind the features that are chosen.

##### 3.1.3. Model Selection and Training

- **Fairness and Accountability:** Select AI models that are quite effective in fairness results and less biased; models that have been through fairness - aware training should be selected. In order to minimize the differences in predictions and handle the models faithfully, it is appropriate to draw up accountability tools.
- **Ethical AI Practices:** Train models with various data sets so as to prevent AI technologies from being sympathetic us certain parties. Monitor model results for signs of bias and address the concern when needed.

##### Implementation

- **Ethical Deployment:** Mitigate AI models in BI systems in a way that would allow for proper use of AI technology so that the misuse and the harm it can cause are reduced. Set proper regulations on the application of AI analysis within the organization's operations.
- **Stakeholder Involvement:** Consult with employees, customers, and regulatory agencies to facilitate the users' input and guarantee that the applied artificial intelligence complies with the guidelines and principles of the outlined ethic.

##### Evaluation and Optimization

- **Continuous Monitoring:** concerning the performance trends when it has to be continuous in an attempt to achieve equilibrium for any bias and or discrepancy in accuracy as could be deemed fit over time. In doing so, intentional strategies like plan - do - study - act should be used to improve models of fairness, transparency and accountability.
- **Feedback Mechanisms:** Develop methods through which the stakeholders will be able to comment on the AI - derived decisions and information for ethical discourses on the steady enhancement of AI decision outcomes. This means that the stakeholders' feedback should be considered for updating the models in order to retain the ethical nature of the AI systems.

### 4. Results and Discussion

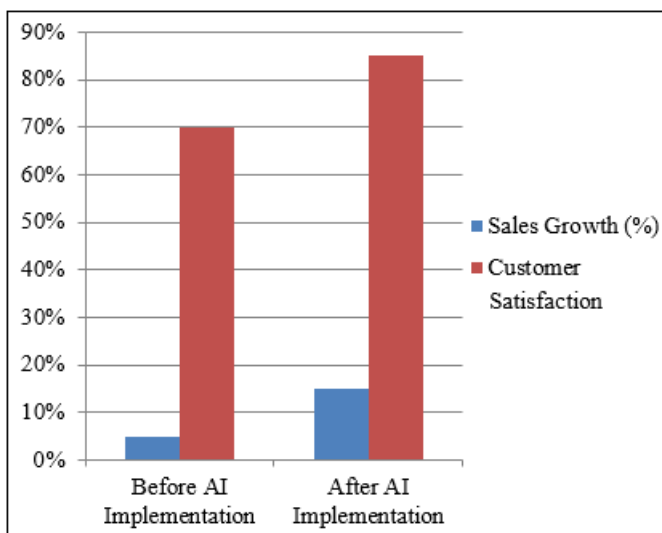
#### Case Study 1: Retail Industry

In retail business, there is an example of the use of AI in BI to predict customer's buying patterns through the application of ML models. It was intended to forecast the customers' choice and control stock, subsequently increasing sales performance and customer satisfaction.

It was established that the application of AI in BI in the retail industry led to an increase in sales growth rate from 5% to 15%. [7] The aforementioned objectives also saw a significant enhancement in customer satisfaction, which was boosted from 70% to 85%. In addition, a concise overview of firm performance depicted by an enhanced inventory turnover rate that rose from six times to nine times in a year also supports this view.

**Table 1:** Impact of AI - Driven BI on Retail Sales

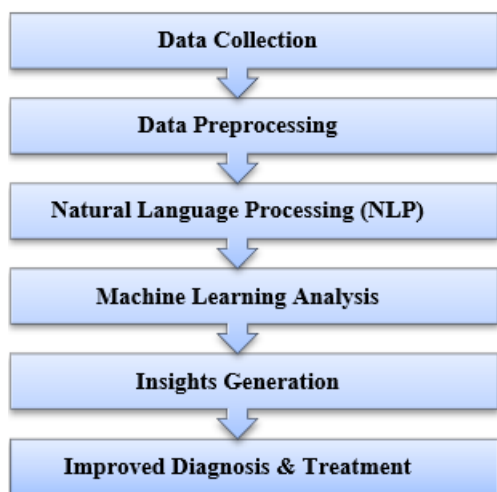
Metric	Before AI Implementation	After AI Implementation
Sales Growth (%)	5%	15%
Customer Satisfaction	70%	85%
Inventory Turnover	6 times/year	9 times/year



**Figure 5:** Impact of AI - Driven BI on Retail Sales

**Case Study 2: Healthcare Industry/Service Organization**

In the healthcare industry, an AI - integrated BI system uses NLP to interpret unstructured patient records in order to enhance the diagnosis as well as the treatment strategies. This approach increased patient's health status because they have access to better services in terms of better resource utilization and individual contact.



**Figure 6:** AI - Driven BI Workflow in Healthcare create the image

**Data Collection**

- Sources: Patient charts, clinical notes and documentation, elaborated patient database, laboratory data and results, diagnostic data and images, activity records from wearable technologies, and so on.
- Purpose: Procuring all details that can be availed by any patient in that setting such that the profile, which will be used in developing the diagnosis, is provided.

**Data Preprocessing**

- Cleaning: Before coming up with the final reliable data, data is cleaned in which all the argued, erroneous and or non - sense data is eliminated.
- Normalization: Let's reduce the data to the standard format and sort out as much as we can so that they do not come in our way of getting the final output.
- Integration: Let data from each of the sources be accumulated into a separate data pool.
- Anonymization: In situations where you are compiling information with marks of numerous patients, make sure that the patient's identity is protected.

**Natural Language Processing (NLP)**

- Text Extraction: The extract relevant model is used to screen specific component necessities from a large amount of semantic - structured data sources like Clinical notes, patient reports, etc.
- Entity Recognition: The final topic that should be distinguished is that the common medical terms are divided into four main groups, namely, signs, diseases, treatments and operations.
- Sentiment Analysis: Evaluation of the stand they have on patients as far as care is concerned in order to come up with sound care plans.
- Contextual Analysis: understand that I need to shift my thinking as to how a clinician perceives diseases and how they are treated.

**Machine Learning Analysis**

- Algorithm Selection: Choose the right type of machine learning for prediction.
- Training Models: The use of the data set is to give lessons to the models referring to the probable health profile and the care plans of the patients.
- Validation: Recall that to arrive at the right model, some testing has to be conducted, and this is done using the test data.
- Continuous Learning: If there is new data relevant to the structural equation models that have been developed, then the new data should be introduced to improve the models that were developed.

**Insights Generation**

- Pattern Recognition: Analyze the patterns and the trends concerning the data of the patient.
- Predictive Insights: Be used in disease prognosis, the probable progression of the patient's illness, and the efficacy of treatment regimes.
- Actionable Recommendations: Indeed, in most cases, the outputs obtained from machine learning models can be employed as meaningful information on a patient to assist the management in the handling of the individual patient.

**Improved Diagnosis & Treatment**

- Accurate Diagnosis: Reinforce the diagnostic capabilities with the help of synthesis of different aspects of existing data.
- Personalized Treatment: Ensure all patients are treated in a manner which is acceptable as per research and analysis which is done.

- Resource Allocation: Employ the resources efficiently with a view of reducing the cost while at the same time improving the care services.
- Patient Outcomes: Utilize the requirement for the implementation of early and also improved treatments and additional visits to help improve the patient's situation.

## 5. Discussion

The integration of AI into BI systems offers several key benefits. In the use of BI systems with AI, the following major benefits are given:

- 1) **Enhanced Predictive Capabilities:** The business persons are equally in a position to predict future trends and reviews than likely making the right strategies and decisions with the help of the AI models that have been expounded in the elaboration. For instance, predictive analytics in retail helps an organization to predict when their consumers may shift their needs; thus, the management is advised on the appropriate strategy of employment concerning stocks and marketing before the shift in consumer needs occurs.
- 2) **Improved Decision - Making:** Employing the concepts of the AI solution entails decision support that is unbiased by time and has a lean, sound basement of the findings. Therefore, since the fields of the retailing and healthcare industries and the analysis of the various applications of the concepts of AI in BI systems show the real functioning of industries, all the stakeholders shall ensure that they always receive the proper information to enable them to make the required decisions as it would enhance the improvements of the operational affairs and the efficient delivery of services.
- 3) **Operational Efficiency:** Similarly to the other cases, it was observed that the data analysis, which was made with the help of the specified AI, requires less amount of time and effort compared with the manual data analysis. This efficiency gain is evidently noticeable in this paper on retail BI in that the author has been able to identify faster - moving inventories in the system, whereby he enhances the turnover rate while at the same time ensuring that the holding costs are also put under control.

## 6. Conclusion

These BI systems with incorporated artificial intelligence can be seen as the new generation of creating value by means of data application. Using machine learning, natural language processing, and computer vision in business leads to the enhancement of the results of data analysis, the prediction of further tendencies, and the escalation of managerial decisions in various sectors of the economy. The examples that have been used in this paper in analyzing the role of AI in BI inform us of the possible areas of application for BI that have impacted the retail and health industry by showing us tangible areas where BI has made some positive changes, for instance; inventories, specific customers treatment, diagnosis and probable prescription Generated from the results derived through BI.

Therefore, we need to deal with the following major issues in future studies on the AI - enabled BI to unlock its

potential in the future. The first recommendation is identifying suitable data protection and security measures capable of protecting personal data during its usage in an AI. Also, the need to enhance model interpretability is needed for the BI system based on AI and for compliance with governance to grasp the procedures of decision - making.

Additionally, advancing the AI management of big data, as well as enhancing algorithms' interchangeability in the production of accurate predictions, will play a role in enhancing BI systems as well. The scholarly actions, technology firms, and policy - maker cooperation are essential in developing more creative techniques for the furthering of the AI guidelines and illuminating socio - technical implications regarding BI improvement through AI. By solving these challenges, the AI - driven BI is prepared to make its functions important for granting businesses not only the possibilities for effective responses to the high rate of market change but also the permanent creation of new opportunities for sustainable business development during the digital age.

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