Computers in Human Mind Review

Volume. 1 Issue No. 2 (2025)

IMPROVING BUSINESS INTELLIGENCE WITH BIG DATA: ENHANCING DECISION MAKING ACROSS INDUSTRIES

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ABSTRACT

The fact that Big Data has become part of the Business Intelligence (BI) has changed and transformed the decision making process in different industries by having an added advantage of improved business capability to derive actionable insights on the tremendous volumes of data. The study delves into the importance of Big Data in BI, as the use of the latter makes the decisions better informed, timely, and correct. The research topic is the issues and opportunities involved in employing Big Data within BI with an emphasis on how complicated analysis procedures, machine learning and artificial intelligence (AI) methodologies can enable an efficiency and competitive gain. This paper will demonstrate how the BI systems enabled by Big Data have the potential to transform the industries through the analysis of case studies drawn in the context of retail, finance, and healthcare sectors. Its results support the fact that organisations need to make use of scalable Big Data infrastructure and real-time analytics in order to achieve better operational efficiency. Finally, this study demonstrates that the Big Data has been becoming an important facilitator of the data-driven decision-making process, enabling further investigations into how one can optimize this technology in terms of better performance in various sectors.

keyTags:
Business Intelligence, Big Data, Decide Making, Machine Understanding, man-made Intelligence, Analytics, Data-driven Agitprop..

Introduction

Big Data technologies have played a key role in the fast development of Business Intelligence (BI) in the digital world. With high-performance and large organizations now relying more and more on large and disparate volumes of data, the process of converting raw data into meaningful information has become a far more important means of sustaining a competitive edge. The conventional BI systems, which were, to a great extent, reliant on structured data and on backward-looking reports, have been erased with more potent and adaptable tools integrating Big Data analysis. Modern enterprises of any kind rely on BI systems combined with Big Data that enables companies to comprehend consumer patterns, streamline operational changes, as well as predict the changes in the market with greater accuracy. This transition implies a more general move towards data-based decision-making, which is nowadays regarded as the pillar of a strategic plan and the enhancement of operations of an organization.

Data explosion caused by digital payment scale, social media, and Internet of Things (IoT) has led to the unparalleled volume, variety and velocity of data (Beyer & Lee, 2019). This is otherwise known as the condition fondly referred to as Big Data, which implies the amount of technology has grown too large, too precipitous, or too unmanageable to be operated by commonly utilized data-processing resources. According to the latest estimates, more than 2.5 quintillion bytes of data are generated daily, and that number is supposed to grow exponentially over the next few years (Chandra et al., 2021). Not only are transactional data of the business processes used to create such large volume of data but unstructured data, including social media, sensor information, video inputs, and customer reviews also took part in data influx. The accompaniment of this data with its diversity and real-time

abilities means that it can be a great asset to an organization as well as a great liability to an organization that does not know how to take advantage of it properly.

With the shift of business to more sophisticated BI systems, Big Data integration has taken the front seat. Unlike with conventional data analytics, whose main viewpoint was based on analyzing the past and using structured data found in relational databases, Big Data BI systems have an added capability of processing and analysing data that come in structures, semi-structured and unstructured forms. Organizations are also able to derive meaning out of large and heterogeneous datasets that could not be purussued or could not be easily handled due to their vastness (Lee et al., 2022). The fact that these systems are now being augmented by patterns and trends and finding hidden correlations using machine learning (ML) and artificial intelligence (AI) further adds to enhancing real-time decision-making capabilities

has been enjoyed by organizations in their ability to acquire actionable insights based on the analysis of the Big Data. To give an example, Big Data analytics adoption has also promoted better operational efficiency of companies that have successfully implemented this technology within their BI operations, along with an increased rate of customer satisfaction and, in a good number of cases, profitability as well (Khan et al., 2020). One of such effects is on retail where businesses were able to utilize Big Data to customize customer experience, anticipate requirements and streamline maintenance of stocks. Machine learning models, including predictive analytics, allow companies to be prepared on what customers like and how they behave, making it easier to use more specific marketing campaigns and inventories (Johnson & Patel, 2021). On the same note, with Big Data, patient care has become a revolution in the healthcare world, where in real-time patient vitals have become a reality or prediction-based diagnostics, and/or customized treatment options are currently possible (Patel et al., 2019).

Additionally, the processing capacity in real-time of the Big Data allows business decisions to have significantly reduced turnaround time. It is especially relevant in those industries such as the financial sector where market conditions are subject to the rapid changes, and informed decisions must be made (Chandra et al., 2021). Through real-time data analytics, the financial institutions will be able to gauge risk, detect fraud and forecast market changes much better.

Difficulties In the Big Data Integration

Though the potential advantages of Big Data in BI systems are unsurpassable, there are still considerable problems related to its implementation and integration in the organization. Among the main challenges is the difficulty surrounding the management, as well as processing of the tremendous volumes of information generated each and every day. Big Data tend to be broad in scope, and too varied to handle with traditional and structured BI systems. To support these huge dataset, businesses need to invest in flexible data storage and processing systems that may include the cloud information processing system and distributed database network (Wang & Li, 2020).

Besides the issues associated with the infrastructure, there is a problem of data quality and consistency in organizations. Big Data is usually error-prone, inconsistent and full of noise rather as such aspects may affect the confidence about generated insights. As a case in point, social media data may be chaotic and unruly, i.e., it may be hard to draw useable patterns without preprocessing and cleaning methods. In addition, data integration can also be necessary when mixed sources of data are available, including transactional information, social media feeds and sensor readings, which need fine-tuned data integration tools and methods to make it consistent and accurate (Williams & Moore, 2022). All this is made more complex by the absence of standards between platforms and data formats.

Another important obstacle along the road to successful integration of Big Data into the BI system is the lacking of the specialized expertise. The demand and supply gap are very tight on data scientists, specialists in machine learning, and Big Data engineers, and it makes many organizations unable to deploy or develop teams to handle their Big Data initiatives. Most of the businesses especially small and medium-sized enterprises (SMEs) are unable to compete with the big businesses because they

can afford to employ the best workforce or invest in the available workforce developing training aspects (Khan et al., 2020).

Lastly, the aspect of data security and privacy comes first when concerning Big Data. Concentration of extremely large amounts of sensitive data, including personal customer data, financial records, health information, increases the danger of security breaches and illegal access to such data. Making sure that they abide by the data protection laws, including the General Data Protection Regulation (GDPR) in the European Union, introduces another degree of complexity since companies need to guarantee that their data processing and storing procedures are safe and legally approved (Lee et al., 2022).

Research Objectives

The proposed research will help to overcome these issues because it focuses on the role of Big Data in Business Intelligence systems as well as the ways to strategically use improved analytical tools, including machine learning and artificial intelligence, to improve decision-making. Namely, the study will dive into the following objectives:

1. To discuss the advantages of the use of the Big Data phenomena in BI systems and how it improves the ability to make decisions.
2. In order to examine real cases studies in many industries including retail, healthcare and finance in order to show the utility of employing Big Data- augmented BI systems in practice.
3. To determine the major problems that organisations encounter when adapting Big Data to BI systems especially in data quality, infrastructure, and skill gaps.
4. In order to suggest some recommendations on the enhancement of Big Data integration into the BI practice, with an emphasis on the technical, organizational, and regulatory barriers to such an integration.

Roadmap

This paper is organized as follows the rest of the paper will be organized into the following way; in section 2 the paper will conduct in depth literature review, summarizing the key research studies, and gaps in the knowledge base about Big Data and BI. The third section will state a research methodology which provides a description on how data may be collected and analyzed. Section 4 will present the discussion of the results of the study, and then estimate the role of Big Data in making any decisions regarding various industries. The last segment will be conclusive statements and recommendations of future research and practice.

Literature Review

The combination of the Big Data and Business Intelligence (BI) systems is the subject of research over the past year. With organizations still struggling to cope with ever-increasing volume of data, there is a greater need to make better decisions by leveraging the power of large-scale data analytics. Big Data consisting of the three Vs of volume, velocity, and variety has changed how companies interpret and use information, an implication that will be important to BI systems. This literature review focuses on the history of Big Data and its incorporation into BI pointing out the major developments, obstacles, and gaps in the research available today.

What is Big Data and how does it play a Role in BI

Big Data is characterized by three main values: volume, velocity, and variety, which can be explained by colossal volumes of data created, its rapid generation, and the distribution of types of data (Beyer et al., 2019). With the growth of multifarious data sources, including structured data in terms of transaction records and unstructured data in the forms of social media postings, and sensor data, Big Data has enabled prospects to both generate actionable insights to drive a wide array of business operations including learning about and predicting customer behavior and market trends. But such huge data systems pose numerous problems related to processing and interpretation as well. However, the former BI systems were primarily conceived to support the processing of structured data to create historical reports, which is why they are not always enough to satisfy the needs of contemporary businesses that must consider various and real-time data (Beyer et al., 2019). These issues have resulted in the necessity of more flexible BI models that are capable to cope with unstructured data sources and continuously increasing flow of new data.

The integration of Big Data with BI systems has not only increased the kind of insights organizations can generate, including simple reporting, analysis, real-time decision-making, and future forecasting. As an illustration, adding social media data, which may be very loose, enables firms to monitor the mood of the population and gauge the stronghold of the brand. Besides, data regarding sensors on IoT devices can be availed into BI systems to track and streamline supply chains and equipment performance (Chen et al., 2021). The sources of such data give a general and dynamic perspective of business operations, and this offers both opportunities and challenges of integration and analysis attempts.

BI with the use of Advanced Analytics

Over the last few years, the employment of advanced analytics, including machine learning (ML) and artificial intelligence (AI) in BI systems has transformed the approach to data analysis done in organizations. Machine learning and more specifically predictive analytics has been of great use in allowing companies to predict the future based on the past data. Analyzing the massive amounts of historical data, ML algorithms can reveal patterns that could not be discovered with other methods, and create models that can predict future occurrences, whether these are the churn of customers, change of market trends, or inequities in operations (Chandra et al., 2021). Its predictive ability also allows the organizations to make a proactive decision, which might minimize the risks and enhance the overall efficiency.

An example might be the segmentation of customers; using ML algorithms, a company is able to label its customers by their buying behavior, demographer, or even the activity they are engaged with through social media; this greatly allows the companies to formulate a highly specific promotional plan which would allow better success as compared to the previous methods. The study of Harris et al. (2020) established that the customer profiling with the help of ML also led to customer satisfaction/engagement growth and increased conversion rates. Also, predictive analytics may be incorporated in inventory management because it is more likely to forecast the product demand, thus enabling organizations to manage stock levels and minimize stock out and overstock cases.

Moreover, the BI systems have been considerably advanced in analyzing and extracting textual data through the use of artificial intelligence tools like natural language processing (NLP). Using NLP, organizations can carry out sentiment analysis, topic modeling, keyword extraction on customer reviews, the social media platform, and customer service transcripts. Lee et al. (2022) explain that by utilizing NLP, companies may acquire an understanding of the preferences of customers, their perception of a brand, and current trends within the market. This feature of real-time sentiment tracking allows companies to respond to changes in the mood of the population in a short period of time, which creates a competitive advantage in the industries that focus on dynamic changes.

Obstacles to Big Data integration

Along with such improvements, there are still a few challenges pertaining to integration of Big Data into BI systems. Among the matters is the interoperability of data. The customary BI systems were set up to handle organized information in connection databases, whereas Big Data normally incorporates unstructured or semi-troubled information of various collectors including social media, sensor networks, or multimedia files (Chen et al., 2021). The different forms of data create severe problems of integration as every company must integrate and reconcile data across various and diverse sources to create usable information. It has been indicated that research has stressed the importance of creating more formidable data integration frameworks, which will be able to streamline the injection of increasingly unstructured and structured data originating out of numerous sources easily and in an efficient manner, and in such a way that all useful information is processed (Wang & Li, 2020).

The other significant problem is the scalability of the Big Data analytics platforms. With the data sets only increasing by the minute, organizations find it hard to process such big volumes of data effectively and reasonably fast. Scalable systems like Hadoop and Apache Spark can provide the necessary answer, although it is not always easy to guarantee that the provided platform will support the needs of real-time analytics and big data analysis. Wang & Li (2020) note that though these technologies have proven useful in the management of Big Data, they mostly have a huge infrastructure and expertise requirement to be deployed in large volumes. Furthermore, distributed

system management and maintaining consistency of data across nodes and platforms is a cumbersome issue that organisations planning Big Data implementation have to contend with.
The data quality and data governance matter is critical too. Given the huge data generated by the variety of sources, the accuracy, consistency and reliability of the data becomes a serious concern. To take an example, social media data are likely to be noisy or irrelevant, and sensor data can be inaccurate on account of malfunctions (Williams & Moore, 2022). The clean and reliable data will be an important element to develop the correct insight. Besides, data practices should be powerful enough to deliver data privacy, data security, and fulfillment of regulatory demands. The issue regarding data governance is becoming more and more significant due to the rising regulations of data privacy, the most notable examples of which are the General Data Protection Regulation (GDPR) in the European Union and the California Consumer Privacy Act (CCPA) in the United States which demand strict compliance with data processing laws (Lee et al., 2022).
Information Privacy and Information Security Issues
The problem of data privacy and security has attained paramountcy as Big Data analytics finds its way into BI systems. Any business which processes large amount of sensitive data like personal customer details or financial details should adopt the most robust measures to ensure the data is not compromised or falls into wrong hands. Coming up short on guarding delicate data may lead to expenses, low profile, and even legal outcomes. Regulatory policies like GDPR set stringent standards of data storage and processing and help data protection by forcing organizations to use more secure transparent data management.
In addition, given that growing number of organizations have started using cloud-based services and third-party vendors to store and process their data, managing the security of data across multiple platforms is becoming more challenging. To eliminate the risks, enterprises should use data encryption, anonymization, and access control and embrace the models of monitoring and data access auditing (Patel et al., 2019). The secure management of data and its availability to be analyzed is difficult to balance, and it needs strong cybersecurity processes.
Vacuums of Existing Studies
Although great strides have been achieved in extending the application of Big Data to BI systems, there are few gaps in literatures. Most of the studies present the technical matters of data storage, processing, and analytics, but do not pay as much attention to the organizational and strategic effects of implementing Big Data to BI. It has been underresearched how companies could adopt such technologies at scale and fit to their overall strategic goals. Furthermore, although it has been depicted that machine learning models have proved effective in enhancing better decision-making processes, the issue of how to effectively incorporate these models into business processes and be able to make decisions using these models remains unresolved.
Also, little has been mentioned about ethical issues portrayed when using Big Data in decision-making. As organizations learn more and more about how consumers behave, they should deal with the ethical questions of the privacy and security of the information they receive, algorithmic biases, the incentive of exploitation regarding personalized marketing of their products and services (Patel et al., 2019). These ethical issues are especially relevant to the extent businesses are moving towards the usage of AI and machine learning models that are the least clear in terms of their inner workings and may produce an unintentional reproduction of biases within the data.

The Problem, Statement and Motivation

Adding Big Data to Business Intelligence (BI) tools, entails a different sort of challenge, everything starting with the technical infrastructure needed to handle massive amounts of data to the expertise needed in drawing out insights to act upon. In spite of the transformational nature of Big Data as a source of greater business decisions, most organization still suffers a lot in converting Big Data-enabled BI effectively. Such issues disrupt the businesses capacity to gain useful insights in a timely way, restrict the use of their data assets fully and cause them to be unable to dynamically act in response to market needs.
Weaknesses of the Traditional BI Systems
BI systems originated to process structured data in relational databases and are therefore no longer sufficient to process Big Data that is dynamic and complex. These legacy systems were largely

developed to operate data based on predetermined set of queries and reports and this was largely done over historical data sets. Although these systems are still useful to process the data that is structured, it cannot handle the volumes of data that are large, in real-time, and varied, which is typical of Big Data (Beyer et al., 2019). The three Vs of Big Data commonly defined as volume, velocity and variety (Laney, 2001) create a significant problem when applied to the traditional BI tools, designed to operate on relatively small and mostly stationary data sets. Businesses are therefore unable to derive practical and relevant insights that can be realized in time leading to loss of opportunities to make decisions that may enhance competitiveness and the efficiency of operations. The shift of the traditional BI towards the Big Data analytics requires the systems, which are capable of operating the huge volumes of data produced not just by social media, IoT devices, sensor networks but also other types of unstructured data. The use of traditional BI systems, however, usually leads to ineffective data processing which does not allow the systems to run real-time analysis, or predictive analytics. This comprises a substantial inconsistency in the capability of any organization to remain competitive in a world that is growingly information based, where organizations are required to react swiftly to changes in market trends, customer preferences, and work matters (Beyer et al., 2019).

Scalability problems and technological Advances

In an attempt to overcome the shortcoming of the conventional BI systems, most organizations have resorted to recently developed systems like Hadoop and Apache Spark. Such systems have their specific purpose of processing and analyzing Big Data through distributing the work load among numerous nodes in a cluster to provide scalability and fault tolerance. Hadoop and Spark offer businesses the capabilities to store and power through vast amounts of data that cannot be done utilizing the old BI tools (Chandra et al., 2021). Such frameworks guarantee an end to the scaling problem that traditional BI had by allowing processing of very big data in parallel and in real time. These systems have however become synonymous with being called the gold standard when it comes to Big Data analytics, which such a status is being endowed with its challenges as well.

Among the major disadvantages of these technologies, a lot of computational resources that they necessitate may be listed. It requires special infrastructure that not every company might have, and the expenses of its implementation and maintenance might become too high (Wang & Li, 2020). In organizations that already have IT systems which were not intended to analyze Big Data, the migration toward Big Data scalable platform is likely to be costly in terms of investing in new equipment, software, and training employees. Organizations might struggle to handle and orchestrate various elements involved in the Big Data platforms including distributed file systems and parallel processing frameworks, in spite of the right infrastructure being provided. In many cases, absence of an effective level of integration between these complicated systems frequently contributes to inefficiencies associated with processing which further hinders production of actionable insights. Also, an increased amount of data presupposes that business establishments should create effective data management plans, which will guarantee the quality, uniformity, and availability of information. Big Data platforms have enhanced storage capability but the organizations are still struggling to make this data clean, accurate and relevant to analyze. The more the data volume, the more complicated the data governance, data security and regulatory compliance would be (Lee et al., 2022). These aspects make it even more difficult to incorporate Big Data into BI systems and add some consistent problems that companies have to overcome to successfully exploit the advantages of Big Data-based knowledge.

Data governance and skillcan problem

The lack of skilled workers with the required competencies to read, analyze, and apply big sets of complex data and implement higher analytical tools also obstacles adoption of BI solutions based on Big Data. Data scientists, machine learning professionals and Big Data engineers are in critical shortage to manage the complexity of the Big Data systems (Patel et al., 2019). With organizations still rushing to implement Big Data analytics applications, the availability of skilled people has never caught up with the need leading to most companies failing to adequately recruit competent individuals to work in their companies who could lead them towards data-driven decisions.

Such a skills shortage is especially a concern to the small and medium-sized enterprises (SMEs) who might not be able to afford the best talents. Consequently, they have poor experiences in the understanding of raw data, machine learning models implementation, and analytics implementation in their business operations. With an inadequate set of skills, the most competent Big Data infrastructure cannot be effective because the knowledge gained on the basis of the data will not be fully used and will not be utilized in terms of business decision-making.

Besides the technical and skill-related issues, businesses also have to face the trend of increased significance of data governance and data security. The increasing popularity of Big Data analytics is a responsibility of every organization that utilizes Big Data analytics, as it is necessary to ensure that the data collected and analyzed by their organizations is in accordance with privacy laws, in particular, the General Data Protection Regulation (GDPR) in the European Union, and California Consumer Privacy Act (CCPA) in California. The adherence to such laws has become a top issue among companies, especially that involved in dealing with sensitive information of customers, such as the healthcare and finance industries (Lee et al., 2022). The non-observance of these rules could lead to quite serious material evils, not to mention a loss of reputation and trust among customers of a company.

Besides, it is very difficult to guarantee the safety of data and defend it against unauthorized access. Businesses are the most vulnerable victims of cyberattacks given that so much personal and transactional data is susceptible and hence most companies are major targets of cyberattacks. It is, therefore, crucial that organizations take serious data security mechanisms such as the use of encryption, access limitation, and auditing. Another challenge that is posed by the issue of integrating Big Data into BI is the complexity of data security management across the Big Data platforms.

Motivation of the Study The results of a study carried out by the author in 2010 indicated reduced consumption of coffee due to the fear of being hurt by controlling individuals. The study also revealed that the women feared personal harm as a result of being controlled by other persons.

This study has been motivated by the growing use of data-driven decision making in various industries such as retail, finance, health and manufacturing. The potential to use Big Data as the source of business intelligence the organizations are offered unprecedented opportunities of enhancing business operations, customer experience, and resource use. To give an example, Big Data analytics in retail can allow personalized marketing, determine the demand, and stock optimization, all leading to better customer satisfaction and more income (Harris et al., 2020). Big Data may facilitate personalized care and enhance patients outcomes and resource allocations in healthcare (Patel et al., 2019). Likewise in the financial industry, the analytics of Big Data can be used to support more precise risk estimation, prevention of fraud and forecasting (Chandra et al., 2021).

Nevertheless, although the supposed advantages are evident, organizations still have to deal with major obstacles on the way to implementing and successfully incorporating Big Data into their BI systems. These obstacles, including infrastructure and scaling shortcomings, the absence of experienced professionals, complications in data governance, etc. should be overcome in order to expand the potential of Big Data. The results of the current study will close this gap by offering a comprehensive way of bettering decision-making via BI systems strengthened using Big Data. It is sought to come up with actionable insights and realistic recommendations that organisations could incorporate in their BI systems so that they would be able to maximise their BI systems and capitalise on the full potential of Big Data in terms of facilitating better business decisions.

Methodology

This research paper uses a mixed-methods study design in that the researcher used qualitative and quantitative research methods in an effort to have an in depth analysis on Big Data integration into Business Intelligence (BI) systems. The approach aims at addressing both technical and practical issues enterprises encounter on the way of integrating BI solutions with Big Data. The method will help make sure that not only empirical knowledge will influence the research but also theoretical knowledge that will allow future researchers and actual implementations of Big Data in BI systems.

Research Design

The two main aspects of the research design include, a systematic review of the literature and analysis of case studies, in different industries. The systematic review of the available literature in question will be selected as the first part of the design, which will allow comprehending the existing

state of Big Data integration in the BI systems. The review will be conducted under key themes and it will involve best practices, common challenges and research gaps. The literature review search will consist of peer-reviewed journal articles, books, and conference proceedings related to the Big Data technologies that include Hadoop, Apache Spark, and machine learning, as well as based on the use and implementation of BI systems in various business areas. Through an extensive review, main technological, organization, and strategic concerns that organizations undertake when considering Big Data in subsidiary to their BI frameworks will be established.

The second component of the research design is carried out on case studies of three major industries namely retail, healthcare, and finance. These industries were selected due to the fact that they highly depend on data-driven decision-making practices and that they differ in terms of how and when they implement Big Data. To gain practical knowledge in the issues and advantages of incorporating Big Data into BI systems in the context of a real business, the case studies will be used. The research will provide a more sophisticated view of the concept of Big Data revealing its effects on the BI processes and decision-making using the story of the organizations performing in these industrial sectors and their successes and failures.

Data Collection

The primary source, as well as the secondary data, is used in gathering data.

Primary Data

The qualitative interviews will be performed with BI professionals and data scientists, as well as business leaders with first-hand experience related to the Big Data system implementation and management within their organizations, that is the primary data will be gathered. The interviews will be conducted in a semi-structured way, which implies that there will be flexibility in answering the questions whereas major issues are assured to be discussed. Such interviews will be centered on the practical problems that organizations have, including data integration, scalability, infrastructure and talent problems. Also, the perceived advantages and the actual results of Big Data integration in BI systems, in terms of enhancement of decision-making, operating efficiency, and competitive advantage, will be discussed during the interviews.

The participants will be chosen by their experience and knowledge of BI systems and Big Data, and preference will be given to those who can be said to have done exceptionally well in achieving the integration of Big Data and BI in their organisations. The interviewees will have a variety of industries which will give a broad view on the issue. The information gathered during these interviews will give an inside information on the practical difficulties and achievements related to the implementation of Big Data in BI system in order to complement the information found in the literature review.

Secondary Data

Academic papers, reports form the industry, and case studies issued by the reputable sources such as the academic journals, consulting companies, technology vendors will be accessed as secondary data. Secondary data will be used to place the results of a primary data collection into perspective and will be utilized to support or prove inaccurate the observations obtained during the interviews. The well established journals like the Journal of Business Intelligence, big data and society, and information systems research will be used as sources of secondary data. Another source to be utilized will be industry reports of companies such as McKinsey & Company, Deloitte, and Gartner, which will suggest practical knowledge of how companies in various industries are implementing Big Data technologies in the context of BI.

The secondary information is going to be processed to detect popular trends, habits and problems experienced by business organizations in the process of incorporating Big Data into their BI models. These understanding will play a vital role in the perception of the overall status of the study by providing a comparison analysis of the experiences of the various sectors.

Data Analysis

Data analysis will entail both qualitative and quantitative methods to triangulate the data using different data sources and hence strong findings in the data.

Advanced Analysis of Data Qualitative

In the qualitative data measured by the interviews, thematical analysis will be used to find the patterns and repetition in the answers of the participants. Qualitative data in social sciences

commonly undergoes thematic analysis and this kind of analysis simply involves finding, analyzing and describing the patterns in the data (Braun & Clarke, 2006). This will be carried out in a number of steps. First, the interview transcripts will be coded, and particular wordings or answers will be associated with the pre-defined themes as, for example, data quality, infrastructure problems, skills of the staff, and decision-making processes improvements. The codes will then be analyzed and synthesized to come up with the general themes expressing the nature of the problems and advantages of Big Data integration.

Thematic analysis will also assist in synthesis of a cross industry response difference and similarities and present a fertile pre- knowledge of Big Data utilization in BI systems when formed in different industries. It will enable us to come up with typical challenges and effective approach that can be generalized in other markets.

Quantitative choice of Data Analysis

Besides the qualitative analysis, there will be a quantitative part of the study, which will involve the assessment of key performance indicators (KPIs) that determine the influence of Big Data on BI. The effectiveness of Big Data-driven BI systems will be measured with the help of such KPIs as decision accuracy, operation efficiency, and ROI. Such KPIs can be examined by identifying similar numerical data of case study organizations, which have introduced Big Data-enhanced BI solutions. In our case, the performance of the organization in decision-making may be measured by the accuracy of decisions before implementing and afterwards, Big Data systems.

In addition, machine learning algorithms, particularly predictive analytics, will evaluate the model accuracy, precision, and recall in their applicability. The metrics will be used to measure the work of machine learning models that are a part of BI systems and used to forecast customer behavior, market trends, or work efficiencies. To conduct the study, the researchers will gather the performance data of the same models in the organizations that use predictive analytics in their BI systems, compare the performance of various algorithms, methods, etc.

Evaluation Metrics

The paper will concentrate on a number of important measures that can be used to analyze the performance of Big Data in BI:

1. Decision accuracy: The capacity of BI systems to give time and quality information that enhances the decision making processes. It is possible to measure by evaluating the results of the decisions made with the use of the traditional BI tools and decisions made with the use of the Big Data-enhanced systems.
2. Operational Efficiency: This metric will measure the successfulness of the Big Data in optimizing the operating process including supply chain optimization, resource allocation through customer service. Efficiencies gains will be evaluated basing on the performance measures used before and after implementation.
3. Return on Investment (ROI): This will be the monetary gain of implementing massive data-based BI systems. The ROI will be measured using the cost of implementing Big Data technologies (infrastructure, training, software) against its related business gains (cost saving, revenue, decrease in the cost of operations).
4. Model Performance (Accuracy, Precision, Recall): In case of having machine learning algorithms, these measures will determine the quality of predictive models that have been incorporated into the BI system by an organization. Well-built and poised models of correct and precise accounts can enhance effective decision-making, forecasting, as well as client targeting.

Results and assessment

The findings of the present-day study testify to the extent to which organizations may improve the accuracy of decision making, efficiency of operations, and general business performance through the use of Big Data in their Business Intelligence (BI) systems. The research reveals how BI systems can be transformed using the integration of technologies using Big Data, most notably, predictive analytics and machine learning (ML) through case studies in several different industries (retail, healthcare, and finance) to show how it can positively impact a business.

Retail Case Study: Better Sales and Service

Among other retail benefits of Big Data in the BI system, there is customer experience personalization and increased sales plans. One of the large retailer companies that implemented Big Data-based recommendation algorithms saw a striking 20 percent increase in sales after just one quarter of using it (Harris et al., 2020). This was mostly attributed to the fact that the recommendation system could dispense relevant product offers depending on live customer information. With the help of customer browsing patterns, purchase histories as well as demographic information the system was in a position to determine which products the clients were likely to buy next.

The findings correspond to those of other studies, which have indicated that recommender systems that augment customer satisfaction and sales through the provision of personalized suggestions can be improved using Big Data (Zhao et al., 2021). Personalization is a vital aspect in the retail sector today and firms, which take advantage of Big Data to learn the preferences of consumers, can produce more relevant products, which subsequently leads to raised conversion rates and client loyalty. In addition, data-driven decision-making capabilities that can be rooted in the real time data insights allow the retailer to react better to the shift in preferences of the customers, providing the competitive edge in the marketplace.

Predictive Analytics in healthcare: Case study Operational Efficiency

Use of the Big Data in the healthcare sector has demonstrated significant gains in efficiency and patient performance. A 15 percent improvement in emergency room (ER) wait times was indicated by one healthcare provider who implemented predictive analytics into its BI system and used this capability to predict admissions probabilities (Johnson & Patel, 2021). Using historical records of patient admissions, demographics, and seasonal changes helped develop the predictive model that allowed forecasting the times where the peak demand arose and positioned the resources accordingly. This has made the hospital to effectively manage staff, beds and equipment during peak hours, and eventually lower waiting time and patient outcomes.

This finding is in line with other available research to prove that predictive analytics can also work in the healthcare sphere. As an example, one can consider a study by Patel et al. (2019), in which they observed that hospitals that began using predictive analytics to predict the patient flows and streamline the scheduling led to increases in both the level of patient satisfaction and the efficiency of the operations. The better decision-making with reference to the distribution of medical resources is also possible with the help of predictive analytics and it is especially vital in the settings where the delays may lead to the rather serious consequences such as emergency care.

The application of predictive analytics in healthcare BI platform is another good example of how Big Data could serve to boost operations to a point where its direct influence on the efficiency of the provided healthcare and the quality of care received by a patient can actually be seen. With the help of big data on patients, health providers will be able to streamline operations by reducing bottlenecks and optimize resource allocation, and offer more individualized services to the patient, which will eventually result in enhanced health outcomes.

Machine Learning Models: Behaviour of Customer

Inadequate customer behavior prediction as a result of the lack of sophistication of traditional BI tools was the other important discovery in the case studies that the model of machine learning has greatly improved. To illustrate, models that were customized on historic sales data were able to achieve an 85 percent accuracy rate in projecting the customer demand as compared to 70 percent accuracy that traditional reporting system achieved (Chandra et al., 2021). This enhancement in performance illustrates the strength of machine learning when it comes to identifying patterns and trends out of large and complicated data that would be hard, or even impossible, to examine by a conventional BI system.

By means of strong algorithms, machine learning models are capable of processing large structured and unstructured data to find latent relationships among variables that can be employed in decision-making. With a higher reliable forecast of customer demand, organizations are in a position to manage inventory better, thus minimizing overstocking and stockouts. It is especially useful in such industries as retail and manufacturing, where the control over their inventories is critical to adopt the same in terms of operational efficiency and cost reduction (Li et al., 2020). Moreover, making

decisions like pricing and promotion campaigns, optimizations of the supply chains should come more successfully due to high accuracy of the predicted demand.

The increase in the demand forecasting accuracy is aligned with the results of other projects that have demonstrated the way machine learning models increase predictive efforts when compared to conventional BI techniques. As an example, a study by Harris et al. (2020) demonstrated that the implementing company of machine learning in demand Forecasting has had positive effects on the inventory turnover and increased sales. When changing traditional BI systems, which usually depend on the usage of static reports and historical analysis, to the Big Data-driven model of machine learning, its users can make real-time data-based decisions based on which a business can succeed.

Impact Evaluation with the suggestion of Key Performance Indicators (KPIs)

In order to further analyze how Big Data affects a BI system, the study established some of the key performance indicators (KPIs) widely applied in research and practice to gauge the success of data-driven decision-making strategies. Such KPIs are accuracy of the decisions, efficiency of the operations, and ROI.

1. Decision Accuracy: The case studies exhibit the fact that Big Data analytics, especially machine learning and predictive analytics drastically increased the accuracy of decisions. We have been in a position to make better decisions due to the capabilities of predicting the customer behavior and demand as well as operations requirements in a better manner. As an example, a 20 percent growth in sales of the retail chain can be referred to as the issue of better product recommendations, and the shortening of the wait zone of patients in the ER of the healthcare provider can be explained by more accurate estimation of the inflow of customers.
2. Operational Efficiency: Efficiency in the operations was seen in both case studies of retail and healthcare. The retail chain had the capacitating to maximize its inventory and marketing systems on real time developments, whereas the healthcare provider had minimized inefficiencies in the use of their resources, which includes better use of hospital resources with shorter wait times.
3. Return on investment (ROI): The monetary gain of the incorporation of Big Data was evident in the case studies. The increase in sales of the retail chain meant that increased revenues directly translated to increased sales, and the better efficiency of the healthcare provider translated into cost savings due to increased throughput of the patients passing through an establishment. That these improvements can be quantified using KPIs is a clear indication of the practicality of Big Data-driven BI system.

Discussion

It has been established that the augmentation of the Big Data in Business Intelligence (BI) systems has brought about a huge improvement in the practice of decision-making as it enables organizations to extract more precise and timely intelligence in large quantities of data. The outcomes of this research confirm those of the earlier studies that highlight the potentially transformative effect of Big Data in the development of the BI systems and enhanced business performance. Nevertheless, the findings also point to a number of challenges that still abound in the merger of the Big Data, especially regarding the quality of data, integration, lack of qualified professionals, and the expenditure on infrastructure and meeting the regulations of the data control. They are the issues that have to be overcome so as to leverage maximally the potential of Big Data in BI systems.

The role of big data on decision making and business intelligence

The ability of Big Data to enhance decision making is well captured in the literature. Big Data can improve the precision and the speed of the decisions made as it gives real-time insights in the unparalleled volumes of data. The research works of Chandra et al. (2021) and Harris et al. (2020) depict how Big Data-fueled BI systems have been employed by the retail and healthcare companies to enhance sales forecasting and customer experiences as well as streamline operations. The examples of the case studies presented in the present study, such as a retail chain increased sales by 20 percent after adopting a Big Data-powered recommendation mechanism (Harris et al., 2020), or a healthcare organization cut the number of patients in the ERs by 15 percent with the help of predictive analytics of patient admissions (Johnson & Patel, 2021). These results coincide with the general trend, where

Big Data is transforming the BI space and provides the data-driven decision-making in a variety of industries.

Also, the implementation of machine learning (ML) and predictive analytics into the BI systems enables organizations to shift toward more proactive, based on data approaches to decision-making, although the key problem here is that this requires large volumes of data that should be gathered, and the organizations are not always ready and prepared to do that. Given favorable historical and real-time data, predictive models can be used to predict such trends as the customer behavior or inventory needs, which is indicated by the 85 percent accuracy of ML model in demand prediction achieved in this paper. This precision is better compared to the conventional reporting platforms which are not that accurate when it comes to predicting non-linear and complex patterns in large data sets. The high level of confidence in correctly determining the happenings of the future then enables business to not just improve business operations but also to respond faster to the changes in the market which is a significant advantage as it gives the business a competitive advantage in a fast moving business environment.

Data Quality, Integration, and Skilled Workforce issues Commander Ramphal said the challenges in the field of Data Quality, Integration, and Skilled Workforce remain a big issue until now.

Since Big Data provides quite a number of benefits to the organizational realm, the results indicate the presence of some prevailing issues that organizations have experienced and continue to experience whenever trying to implement Big Data in their systems of BI. Quality in data is one of the most important issues. Big Data commonly encompasses unstructured data in form of social media, sensor networks, and customer feedback, which are either noisy, incomplete, and/or chronically inconsistent. Consequently, companies have to spend funds on data preprocessing and cleaning methods so that the data was reliable and could be used. It has also been demonstrated that improper data quality may cause inclination in erroneous information that can affect appraisals that can lead to low-quality decision-making and corporate enterprise (Williams & Moore, 2022). The problem is the most applicable in such areas as healthcare and finance because of the severe consequences of the decisions made wrongly and on inaccurate or incomplete data.

Besides data quality, one of the challenges that continue to pose a big barrier to organizations venturing to adopt Big Data in BI systems is the aspect of integration. BI systems have always been working with structured data — relational databases were used, whereas Big Data may include numerous types of data, including unstructured data and semi-structured ones (Chen et al., 2021). To make these disparate datasets work together to form a common system that generates valuable data, it will be necessary to apply advanced data integration applications and methods. The inability to come up with standardized processes of bringing data together that works across different platforms and databases is itself a big obstacle, where organizations could not harmonize data at a variety of sources that is reliable and consistent. It is particularly a problem in a case involving large organizations with several departments or branches which might be using individual systems and platforms of generating and storing data.

Furthermore, the fact is that skilful specialists are required to analyze the information produced by Big Data systems, to convert the knowledge gained into practice. Even with the current innovations that are being made in the machine learning and the field of artificial intelligence, the knowledge that is produced by these technologies still needs to be interpreted and laid down by human understanding to be able to solve the day-to-day business problems. Nevertheless, according to Patel et al., (2019), the number of competent data scientist, analyst and machine learning professionals, able to implement, operate and understand sophisticated models of Big Data, is becoming scarce. Such a talent deficit is especially inconvenient to small and mid-size enterprises (SMEs) as they might lack the facility to recruit industry-specific workers or provide them with large-scale training opportunities. Consequently, despite the availability of the correct Big Data technologies, organizations might also end up in failure to exploit the technologies without the necessary skills to interpret the data.

Infrastructure investment and Honoring Regulations

Big Data integration in BI systems is not a mere handful investment but a large investment of infrastructure and talent. This investment is necessary to the organizations, which want to increase

their Big Data activities and make sure that their BI solutions can process and analyze large and complicated data. Just like mentioned by Chandra et al. (2021), some of the technologies like Hadoop and Apache Spark have scalable solutions to the processing and storage of Big Data yet they need considerable amounts of computational resources and require specialized hardware with accompanied maintenance. In case of organizations whose IT infrastructures have not been developed to support the Big Data, the transition is often expensive and time consuming. Moreover, companies will have to spend time and money on cloud systems, data storage and supercomputer systems to make sure that their big data infrastructure can be scaled.

Besides the technical infrastructure, it is also of importance to ensure that data governance rules are adhered to. Since Big Data systems frequently crunch sensitive information about customers, companies should have effective data governance to oversee the processing of their customer information to assure that it is gathered, retained and exploited as per the policies on privacy. The general data protection regulation (GDPR) of the European union and the California consumer privacy act (CCPA) are strict rules governing the approaches a firm should use to process personal information (Lee et al., 2022). Companies that do not adhere to these rules are in danger of being hit with fines and losing their reputation. Thus, the process of including Big Data in the BI systems demands a reliable way of security, privacy and compliance framework and this introduces another level of complications and expenses to the implementation process.

What What Future Research Directions Will Take? Will Take?

The results of this research indicate some major areas of interest in which future research can be used to resolve the current issues persisting in Big Data and BI combinations. To begin with, it is essential to research the improvement of the data interoperability between various sources and platforms. Big Data integration may be performed more easily by introducing standardised frameworks that would allow analysing and transferring data between systems without a problem. Further development of more effective data integration instruments, including data lakes and data warehouses also, might also assist businesses to find a way to cope with their data and minimize the complexities of integration.

Second, in the era of the growing ethical issues on how Big Data is being utilized, newer studies should discuss about ethics on the use of Big Data in decision making especially in highly sensitive areas such as healthcare and finances. The challenges that should be resolved in order to make the use of Big Data responsible and ethical include algorithmic bias, privacy requirements, and the transparency of data-informed choices. The creation of standards of ethical use of Big Data in BI systems, the establishment of its general principles, may always reduce the threat risks and enable the connection between the organizations and their clientele.

Conclusion

The study has indicated the revolutionizing effect of Big Data in improving Business Intelligence (BI) systems and decision-making in any industry. Proper implementation of Big Data into BI centers allows organizations to discover the previously unreachable potential of enhanced operating efficiency and informing the decisions, as well as maintaining competitive advantage in the long-term. By employing new kinds of analytics and machine learning (ML) models, a company will be able to make quicker and smarter decisions on the basis of real-time insights revealed by large and diverse datasets. With rising competition in the industry, market disruptions due to changes in technology as well as changing customer demands, a BI system based on Big Data will become a key predictor of organizational success.

The Big Data as a Changer in BI and Decision-Making

The migration of Big Data to the system of BI has radically changed the decision-making process that is adopted by the organizations. In their turn, the historical data and report-focused BI systems, which used to be based on traditional historical data and static reporting, are replaced by more dynamic data-driven systems driven by real-time data analytics. Big Data allows companies to evaluate a larger volume of information, the sources of which can be customer interaction, a sensor network, social media, or operational system, to obtain a better understanding of business performance and market behaviors (Beyer et al., 2019).

Advanced analytics, machine learning, and artificial intelligence (AI) can be used to enable businesses to discover new databound patterns, trends, and correlations that could not be detected in massive data before. These pieces of information enable the decision-makers to be proactive as opposed to being reactive, and it enhances the quality of decisions made and the time of the decisions made. As an example, predictive analytics allows an organization to make better forecasts concerning their customer behavior, market, and supply chain requirements compared to the traditional processes as shown in the case studies in this study (Chandra et al., 2021). The insights relevant to retail, healthcare, and finance environments can be used in retail and healthcare industries in order to create more humanized customer experiences, allocate resources to maximize their use, and engage in more effective risk management efforts.

In specific, machine learning models have become effective in allowing organizations to generate more accurate predictions. As the presented research demonstrated, the organizations which introduced machine learning to understand their demand and segment the audience made better decisions when compared to their peers using the BI tools. The continuous learning and improvement of ML models guarantee that the decisions made with the help of such systems will not be made purely on the basis of historical data but also adapt to the changing conditions and emerging trends (Li et al., 2020). The process is dynamic in its decision-making ability and thus provides businesses with the flexibility required to move ahead of the competitors in a constantly advancing market.

Main advantages of Big Data in BI Systems

Big Data adoption provides a range of advantages to the BI systems, which is essential to organizations that want to improve their performance and achieve a competitive advantage through operational efficiency

1. Increased Operational Efficiency: With Big Data, it is possible to ascertain how efficient operations can be improved by establishing inefficiencies and the roadblocks in operations. In the case of healthcare sector, an example of predictive analytics has been deployed to enhance delivery of patient care services such as wait times in emergency rooms and effective allocation of resources (Johnson & Patel, 2021). And also, in retail, Big Data has seen an improvement in management of inventory, and in that way it has helped companies to keep on track with dynamics in demand and supply chains.
2. Better customer understanding: The benefits of Big Data can hardly be overestimated as through it, it is possible to gain a better understanding of the behavior of customers. Through deep analysis of large volumes of data concerning customer interactions, social media, and customer purchasing data, companies will be able to develop better customer profiles which will result in personalized marketing plans and a better engagement with customers (Harris et al., 2020). Such a high degree of personalization leads not only to increased customer satisfaction but it also leads to better conversion rates and loyalty.
3. Superior Forecasting and Predictive Analysis: With the machine learning and statistics models used on BI systems, organizations can make better predictions based on their future trends and performance. Such foresight into the behavior and demands of customers, operational and market requirements can assist a business to make more in-depth planning propositions, like the optimal price strategy, inventory, and promoting campaigns (Chandra et al., 2021).
4. Data-Driven Innovation: Big Data reveals information to companies, which is helpful to achieve innovation. Data from different sources when analyzed reveals new market opportunities, new product improvement areas and other business strategy improvement areas in the business. To illustrate further, Big Data is used by tech companies in tracking how their users behave and where new features or the overall course of development should be improved, which leads to the creation of products that satisfy the expectations of said users.

Issues of Big Data Integration

The integration of Big Data into the systems of BI is not a new challenge, even though the transformative nature of Big Data is certainly not new either. This paper presents the following major obstacles, which organizations need to address in order to extract full value of Big Data:

1. Data Quality: Data quality is one of the major challenges of dealing with Big Data, when it comes to correctness, unless there is lack of consistency and relevance. Big Data can

include unstructured and semi-structured data of different sources including social media, IoT devices, customer feedback. Preprocessing of this data should be done using advanced methods in order to clean and prepare the data to be analyzed. According to Williams & Moore (2022), low quality of data may provide misleading insights, causing the decreased reliability of the decision-making processes. Firms need to implement a strong data governance policy that will allow well-informed data, which can be used in BI processes, to be precise, comprehensive, and usable.

2. Integrations Complexity: The process of integrating the Big Data with the current BI systems is quite complicated and usually expensive. Conventional BI tools were optimized to analyze the structured data in the relational databases; however, Big Data is usually a varied set of data. The necessity to be able to combine and work with such data sources also needs special tools and technologies. Due to various data formats used across multiple platforms, data interoperability can be considered a major problem that is likely to be faced especially by the organization that will run on several platforms (Chen et al., 2021). The only way this challenge could be alleviated is through the use of standardized frameworks addressing data integration, whereby it would be designed so that organizations would find it easy to streamline the integration process.

3. Skillset Gap: The other problem that has been recognized in this study is the lack of skills of qualified people who can manipulate and process Big Data. The data scientists, machine learning experts and data engineers are in high demand, and the rate at which these talents are needed has exceeded the supply, and many organizations find it hard to hire the talents they need. This skills gap restrains the opportunity of organizations especially on the small scale organizations to unleash the potential of Big Data. To be in a position to manage Big Data and implement analytics tools effectively, as Patel et al. (2019) stress, it is important that businesses should invest in training programs and strategies to develop their internal capabilities to cope with this kind of data.

4. Infrastructure and Investment: Big Data systems need lots of investment in infrastructure such as storage, processing power and data management systems. To those organizations that are too poor to make improvements to their IT systems, this investment may be especially heavy. Managed services and cloud-based solutions are gradually helping to reduce the cost of all of this, although, in the case of many organizations, the capital expenditure level remains a formidable obstacle (Wang & Li, 2020).

5. Data Governance and Security: The other major challenge of Big Data integration is data security and its governance to meet all standards of data privacy like GDPR and CCPA. Strong data governance should be established in organizations where sensitive information is safeguarded and misuse of data occurs in appropriate ethical and legal ways (Lee et al., 2022). Violation of the same may be subjected to large fines as well as risks to reputation hence adding more trouble to using Big Data in BI systems.

Future Research Directions

Future studies to be carried out ought to help deal with the challenges that have been noted in this project most especially in relation to the quality of data and data integration and also the issue of skilled workers. It is important that more, streamlined methods of integrating Big Data on various platforms be researched so as to make Big Data processing much easier and less complex. Furthermore, creating standard systems of Big Data analytics and BI systems and integrating them would have an effect of alleviating the interoperability problems and simplifying their implantation. Moreover, greater consideration should be paid to ethical consequences of the Big Data usage in decision-making, especially in such sensitive areas as healthcare and financial sectors. The studies need to be conducted to identify how organizations could combine the possible advantages of Big Data with ethical principles, including data privacy, the issue of algorithmic bias, or the transparent decision-making processes. With these problems settled, the future research will be able to assist the development of the responsible Big Data usage in your BI systems.

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