Analytics and Big Data Management in the Age of Artificial Intelligence

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Abstract

Because they may provide insightful information for better decision-making processes, big data (BD) has recently caught the attention of academics and practitioners. Data analytics, which aims to produce valuable information from massive amounts of data, is quickly gaining popularity and being used by many enterprises. Although the analytics process, including the implementation and usage of Big Data Analytics (BDA) technologies, has a positive influence on organizational performances, develops new income streams, and potentially gains a competitive edge over business competitors, businesses view it as a tool to improve operating effectiveness. However, there are a number of analytical methods to consider. Given the importance of both BD and BDA, this article contains cutting-edge research that provides an in-depth analysis of the BD issues and BDA tactics proposed, endorsed, and used by companies to assist others in better understanding this environment and making better financial choices.

Keywords: Big data, artificial intelligence, analytics, operational effectiveness, and competitive advantage.

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1. Introduction

Today, a huge quantity of data is produced and exchanged by businesses, government entities, a variety of for-profit and non-profit organizations, science, and research [1]. Over

the last 10 years, big data has been more important in the sectors of communication, information, and computer science technologies as a consequence of several technical developments and the widespread use of potent computational tools. Because digital technology is developing so quickly, the volume of digital data is growing quickly [2]. As a consequence, a lot of data is generated from many sources, such as social networks, telephones, sensors, etc. The massive amount of complex and heterogeneous data that is streaming in from all locations, at all times, and with all devices has unquestionably ushered in the "Big Data era," often referred to as the "Data Deluge" [3].

Big data, analytics, and artificial intelligence are fantastic tools that can do challenging tasks at a level that is beyond the capability of a person. The three are more well-known now because they can be used to compile, organize, and analyze vast collections of heterogeneous data in order to find hidden links and correlations that might be utilized to address a variety of sustainability-specific problems [1][2]. However, there are many barriers to overcome when we examine these technological advancements and provide solutions to diverse problems.

2. Literature Review

The literature on big data analytics (BDA) techniques has been reviewed in a number of different ways. However, none of that research provides particular attention to a comprehensive and organized investigation of AI-based BDA procedures. The AI-driven BDA techniques will be covered, along with the benefits and drawbacks of each technique [4]. The four primary areas employed in this study to categorize the research results on BDA methodologies were machine learning, knowledge-based cognitive reasoning techniques, decision-making processes, as well as associated methods and optimization theories. Numerous sectors, including financial services [5], computer networks [3], agriculture [6], healthcare [7], environmental research [8], and transportation [9], have shown the value of BDA.

Multi-criteria decision-making is a critical strategy that may aid and improve such processes when making judgments when the best choices must be made in the face of various and conflicting criteria. To address this research problem, [8] offered feedback integrated fuzzy analytic hierarchy technique and did performance studies on a variety of relevant multi-criteria decision support models used in the supplier and contractor selection process. It is determined to combine a variety of fuzzy-based strategies with an analytical hierarchy

method in order to address the complicated difficulties in the domain. The suitability of the model was compared to various models that were already in use using three distinct datasets. It was found that the proposed model had more accuracy when compared to the other models. As a consequence, decision-maker algorithms may benefit from the creation of emotional models in the assessment and ranking criteria for option selection systems [10].

Even though there is a wealth of literature on the adoption of emerging technologies, research on the influence of entrepreneurial orientation (EO) on the creation of new technology (i.e., BDA/BDA-AI) is still very few. This is despite the importance of understanding this phenomenon. The little research on organizations adopting new technology that is available is mostly focused on determining the direct effect on operational efficiency or the indirect impact [6–8]. [11]. The subject of how an entrepreneurial mentality influences the adoption of new technology and Organizational Performance (OP) is not further explored in this research [12]. Therefore, before taking any action, it is critical to comprehend the influence of the factors that are pertinent to the situation.

3. Analytics of Data

Data analytics is a key concept that deals with the discovery, comprehension, and information sharing of unique knowledge and important patterns from vast volumes of data in several application fields for rapid, precise, and effective decision-making. Using methods and algorithms from many academic fields, including mathematics, information retrieval, statistical data, machine learning, and high-performance data processing, it is a novel technology that efficiently manages large data difficulties. [4] [13].

To mine the huge data we already have, rich brains and intellectuals are accessible in emerging countries, and crucial technologies like data mining, machine learning, statistical modelling, and management are at our disposal. Artificial intelligence (AI) is one of them and it also has an impact. Managing data growth, integrating diverse data sources, and ensuring security are issues we must resolve despite all the benefits that big data analytics may provide. Data validation issues, organizational pushback, and problems with data governance are a few more.

3.1 Analytics and Big Data

Unstructured, structured, and semi-structured data are all included in the phrase "big data," which refers to a growing category of data that takes many different forms. Current database management solutions cannot handle such a massive volume of different data (DBMSs).

Strong technology and cutting-edge algorithms are consequently needed for processing enormous amounts of data [14].

A growing amount of data that encompasses semi-structured, unstructured, and structured data in a number of ways is referred to as big data. Current database management solutions cannot handle such a massive volume of different data (DBMSs). Strong technology and cutting-edge technologies are consequently needed to handle enormous amounts of data. There are many Vs that may be used to describe big data, including velocity, volume, variety, and veracity (Figure 1) [15].

Velocity: This concept refers to the pace at which data is produced as well as the rate at which it must be processed in order to meet demand. Data flows, the creation of standardized records, and distribution accessibility are required for this. The rate of data production, processing, and analysis is constantly increasing as a result of real-time production processes, demands originating from integrating data flow with business processes, as well as decision-making activities. Although fast data processing speeds are required, processing speeds vary according to how the data flows are handled;

Volume: There are many factors that contribute to the growth of data volume in business applications, including the number of transactions, other common data types, and unique data types. Having too much data creates a storage problem and makes processing it considerably more complex;

Although historically the sorts of produced or filtered data were less diverse, simpler, and generally organized, IT workers have always had trouble translating vast volumes of transaction data into decisions. More information is presently accessible for analysis, and new channels such as evolving technologies, mobile sources, instant messaging, including social media, log files, blogs, the Internet of Things, and online advertising provide unstructured or semi-structured data. It also includes information on share prices (stock ticker), financial transactions, etc. Documents, hierarchical data, tabular data (databases), XML, emails, click streams, data metering, photographs, audio, and video, as well as all of these, are included.

Veracity: explains how reliable or shaky the data is. BD's quality is less controlled since it comes from several sources that cannot guarantee the caliber of the data and how it is presented. Skilled data analysts must assess the conformance, accuracy, and authenticity of the data analysis.

Value, volatility, and visualization are some additional Vs and features that have been used to further define big data in the current day (see Figure 1).

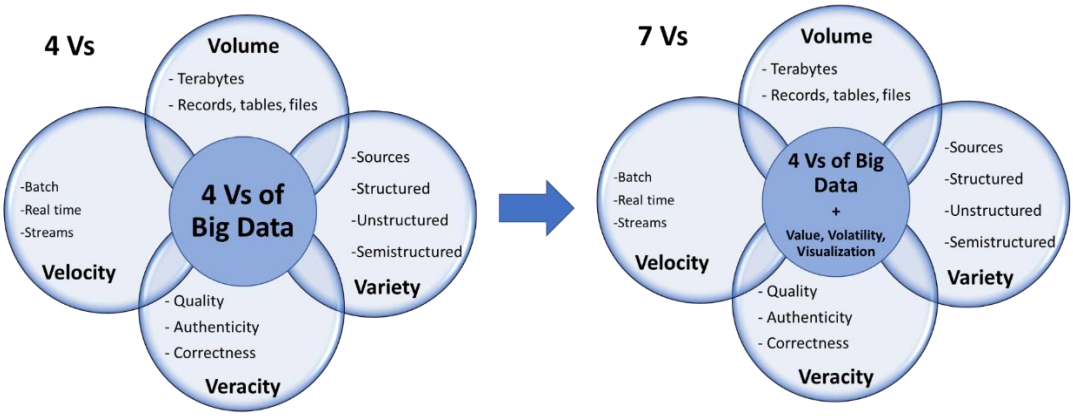

Figure 1: The Expanding Vs of big data

Conceptual modelling in the age of large data, 1.1.1

We have condensed our ideas and expectations regarding these topics for this workshop and subsequent iterations using novelty, experience, and new trends that have evolved over the previous three years. In order to react effectively to the "Big" keyword and in particular to understand that "big data" transmit complexity into interacting with data in many dimensions, the phrase "big data" is extremely broad and usually easily understood via a graphic depiction. There are currently far too many instances in which the term "Big Data" is utilized. In industries including banking, Internet search, and business intelligence, large data sets pose difficulties for academics, corporate executives, entertainment and marketing specialists, and government authorities [16]. Several sectors have seen an upsurge in the need for data management. When discussing the three factors of volume, velocity, and diversity in relation to data management challenges in e-commerce, for instance,

• On Volume: Since e-channels are less costly, organizations may be able to contact more clients or collaborators. Due to the explosion of data that must be collected for e-commerce, which may be up to ten times more than the quantity of data about a single transaction, the number of data that must be handled has rapidly expanded.

• On Velocity: E-commerce has increased point-of-interaction (POI) speed, which has affected how quickly interactions generate data that may be used to support them.

• On Variety: The large variety of incompatible data formats, non-aligned information structures, and particularly conflicting data interpretations provide the greatest challenge to

effective data management. Where does large data come from? the ability to "keep everything," new and widely used sensors, and consumer "data exhaust."

Data Management 1.2

For the administration of large data and the creation of high-quality data analytics, massive data management is essential. It entails efficient data collection from many sources, efficient data storage using a variety of methods and technologies, efficient data cleaning to eliminate errors that cause the data to be arranged inconsistently, and efficient data encoding to ensure privacy and security. This process seeks to ensure that reliable data is properly handled, securely stored, and maintained [5].

In order to extract information from the data, many analytical approaches are developed, including:

1. Descriptive analytics: The goal of descriptive analytics is to characterize past occurrences by analyzing historical data from an organization.

2. Prescriptive analytics: Prescriptive analytics, which recommends the optimal course of action to enhance business operations, uses both descriptive and predictive analytics.

3. Predictive analytics: Predictive analytics focuses on a variety of statistical modeling and machine learning methodologies in order to foresee future outcomes.

1.3.1 Machine learning

AI has seen both winters and springs since it was first developed more than 60 years ago. It seems that in recent years, the development of big data and supercomputing technologies has strengthened AI. The present generation of artificial intelligence is growing swiftly and is once again a major research topic. AI isn't defined in a single, universally accepted way. It is often defined as the capability of computers to learn via experience, adapt to new inputs, and execute different tasks similar to those carried out by a human. The terms artificial intelligence and AI technology were originally used in the 1950s. Thanks to the speedy development of Big Data technologies, such as enhanced computational storage capacity and very fast data processing equipment [8]–[13], AI is being revitalized by the quantity and promise of Big Data.

The most significant strategic technology is artificial intelligence, according to Gartner's 2018 Technology Trend Survey [17]. Return on investment for digital projects will be determined through 2025 by the potential application of AI to improve decision-making,

reimagine business ecosystems and strategies, as well as revolutionize consumer experiences [18]. 59 percent of firms are still collecting data to build their AI strategy, while the remaining companies have progressed in testing or implementing AI solutions.

2. Big Data Analytics and AI

Businesses may receive pertinent information and trends that might affect their operations using big data analytics. Therefore, in-depth data analysis is needed to uncover the connections between traits and forecast future observations. BDA refers to techniques for deriving conclusions from big datasets. Big data analytics results may improve decision-making and increase organizational effectiveness [11].

2.1 Rewards of Big Data Analytics Based on AI

One may argue that Big Data is what has caused AI to enjoy its current boom and that cognitive computing would suffer without making use of the benefits of Big Data analytics.

Humans may need a lot of time to analyze big data, therefore employing AI methods may make it quicker to comprehend their significance. On the other hand, AI employs clever algorithms to give Big Data meaningful context [14].

Numerous analytics techniques, including as rule-based methods, machine learning, data mining, statistical methods, neural networks, and others, are used to analyze massive data sets more rapidly and correctly while also spotting hidden patterns. Numerous investigations concentrate on this field of study by enhancing current procedures, advancing novel concepts, or investigating the fusion of various algorithms. Greater analytical breakthroughs are required to solve the challenges posed by big data [18].

2.2 AI Decision-Making Potential Benefits

Both the predictions that robots would soon be able to outperform people in a wide range of tasks and the actual achievements have received a lot of media attention. The most important use of AI in history has been decision-making. The functions of AI have been categorized using a variety of categories. In general, AI-enabled systems are better suited to support human decision-making.

As scientists work to create smarter computers, it is now possible for AI to carry out increasingly challenging cognitive tasks that were long considered to be impossible, such as generating implicit judgments, experiencing emotion, and carrying out driving operations [13]. As a consequence, AI systems are doing a wider range of activities independently and

without human supervision or control. There are several papers that discuss how AI is useful when making judgments since it is thought that AI may aid organizational employees in making better decisions, enhance our analytical and decision-making skills, and foster creativity. [19]

The tremendous benefits and implications of the fast-increasing range of AI applications are regularly asserted by developers of AI technology and big organizations. Numerous terms, such as cognitive computing, intelligent executive mechanisms, intelligent software engagement with the product, intelligent software involvement with the product, etc., are being used to describe the systems that are using AI for decision making [20].

In recent years, there has been an increase in interest in studying how AI might be used for automation or enhancement. Some AI researchers and practitioners believe that rather than automating processes, AI should be used to complement human judgment.

Business intelligence's effects on operational performance as a result of business processes have been researched [19–21]. We think that by sticking to the idea of dynamic capabilities, BDA powered by AI helps organizations grow their information processing skills. This synthesis of information is used by managers to reduce ambiguity about customer needs, employee skills, and supplier availability [22]. It aids them in the analysis and incorporation of complex data gathered from many sources.

Conclusion

The application of AI has grown, and factors contributing to this growth include big data, effective algorithms, more processing power, and better storage facilities. As a consequence, AI systems are progressively being integrated into already-digitized processes, which is having an impact on how humans make choices. because information systems experts who can research, comprehend, and assist in the conceptual formulation and responsible application of AI technology have better career prospects. Big Data is still a relatively new phenomenon, but in recent years it has become more significant in a range of industries and countries, making it an interesting subject for academic research and management studies.

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