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Big Data Analytics and Business Intelligence: An Overview

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Abstract: *In the information era, enormous amounts of data have become available on hand to decision makers. Big data refers to datasets that are not only big, but also high in variety and velocity, which makes them difficult to handle using traditional tools and techniques. Due to the rapid growth of such data, solutions need to be studied and provided in order to handle and extract value and knowledge from these datasets. Furthermore, decision makers need to be able to gain valuable insights from such varied and rapidly changing data, ranging from daily transactions to customer interactions and social network data. Such value can be provided using big data analytics, which is the application of advanced analytics techniques on big data. Business intelligence (BI) is a general category of applications and technologies for collecting, storing, analyzing, and providing access to data to help users make better and faster decisions. BI applications include the activities of decision support systems, query and reporting, online analytical processing (OLAP), statistical analysis, forecasting, and data mining. The purpose of this research is to investigate current status of big data business analytics in order to improve business performance using previous data and statistical methods.*

I. Introduction

The term 'Big Data' has been under the limelight, but not many people know what is big data Businesses, governmental institutions, HCPs (Health Care Providers), and financial as well as academic institutions, are all leveraging the power of Big Data to enhance business prospects along with improved customer experience. Almost 90% of the global data has been produced in the last 2 years alone.So we know for sure that Big Data has penetrated almost every industry today and is a dominant driving force behind the success of enterprises and organizations across the globe.

According to Gartner, the definition of Big Data –
"Big data" is high-volume, velocity, and variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making."
This definition clearly answers "What is Big Data?" – Big Data refers to complex and large data sets that have to be processed and analyzed to uncover valuable information that can benefit businesses and organizations.
However, there are certain basic tenets of Big Data that will make it even simpler to answer what is Big Data:

- It refers to a massive amount of data that keeps on growing exponentially with time.
- It is so voluminous that it cannot be processed or analyzed using conventional data processing techniques.
- It includes data mining, data storage, data analysis, data sharing, and data visualization.
- The term is an all-comprehensive one including data, data frameworks, along with the tools and techniques used to process and analyze the data.

What Is Business Intelligence?

Business intelligence (BI) is a set of methodologies and technologies that enable business managers to access data, manipulate it, and conduct analysis for decision making. BI has three main components. The first is a data warehouse, which is a repository that collects data from multiple sources and organizes it for decision making. When the amount of data is really huge with the high rate of analysis processing, online business transactions may be slowed down if a separate data warehouse is not used with BI. A data warehouse can be replaced by a data mart for small companies with small amount of data and simple data analytics. The second component is BI tools or analytics and visualization for manipulating, mining, and analyzing the data in the data warehouse. The third and final component is the business performance management (BMP) for monitoring and analyzing the performance of the organization [1]. A user interface enables users to interact with the BI and business performance management tools.

II. Business Intelligence and Analytics

Traditional BI market share leaders are disrupted by platforms that expand access to analytics and deliver higher business value. BI leaders should track how traditionalists translate their forward-looking product investments into a renewed momentum and improved customer experience.

The BI and analytics platform market are undergoing a fundamental shift. During the past ten years, BI platform investments have largely been in IT-led consolidation and standardization projects for large-scale systems-of-record reporting. These have tended to be highly governed and centralized, where IT-authored production reports were pushed out to inform a broad array of information consumers and analysts. Now, a wider range of business users are demanding access to interactive styles of analysis and insights from advanced analytics, without requiring them to have IT or data science skills. As the demand from business users for pervasive access to data discovery capabilities is growing, IT sector wants to deliver on this requirement without sacrificing governance.

While the need for system-of-record reporting to run businesses remains, there is a significant change in how companies are satisfying these and new business-user-driven requirements. They are increasingly shifting from using the installed base, i.e. traditional and IT-centric platforms that are the enterprise standard, to more decentralized data discovery deployments that are now spreading across enterprises.

III. Types of Big Data

Now that we are on track with what is big data, let's have a look at the forms of big data:

- **Structured**

By structured data, we mean data that can be processed, stored, and retrieved in a fixed format. It refers to highly organized information that can be readily and seamlessly stored and accessed from a database by simple search engine algorithms. For instance, the employee table in a company database will be structured as the employee details, their job positions, their salaries, etc., will be present in an organized manner.

- Unstructured

Unstructured data refers to the data that lacks any specific form or structure whatsoever. This makes it very difficult and time-consuming to process and analyze unstructured data. Email is an example of unstructured data.

- Semi-structured

Semi-structured data pertains to the data containing both the formats mentioned above, that is, structured and unstructured data. To be precise, it refers to the data that although has not been classified under a particular repository (database), yet contains vital information or tags that segregate individual elements within the data.

IV. Big Data Analytics

The term "Big Data" has recently been applied to datasets that grow so large that they become awkward to work with using traditional database management systems. They are data sets whose size is beyond the ability of commonly used software tools and storage systems to capture, store, manage, as well as process the data within a tolerable elapsed time [2]. Big data sizes are constantly increasing, currently ranging from a few dozen terabytes (TB) to many petabytes (PB) of data in a single data set. Consequently, some of the difficulties related to big data include capture, storage, search, sharing, analytics, and visualizing. Today, enterprises are exploring large volumes of highly detailed data so as to discover facts they didn't know before [3]. Hence, big data analytics is where advanced analytic techniques are applied on big data sets. Analytics based on large data samples reveals and leverages business change. However, the larger the set of data, the more difficult it becomes to manage [3], Naturally, business benefit can commonly be derived from analyzing larger and more complex data sets that require real time or near-real time capabilities; however, this leads to a need for new data architectures, analytical methods, and tools.

V. Big Data Analytics and Decision Making

From the decision maker's perspective, the significance of big data lies in its ability to provide information and knowledge of value, upon which to base decisions. The managerial decision making process has been an important and thoroughly covered topic in research throughout the years. Big data is becoming an increasingly important asset for decision makers. Large volumes of highly detailed data from various sources such as scanners, mobile phones, loyalty cards, the web, and social media platforms provide the opportunity to deliver significant benefits to organizations. This is possible only if the data is properly analyzed to reveal valuable insights, allowing for decision makers to capitalize upon the resulting opportunities from the wealth of historic and real-time data generated through supply chains, production processes, customer behaviours, etc. [4].

Moreover, organizations are currently accustomed to analyzing internal data, such as sales, shipments, and inventory. However, the need for analyzing external data, such as customer markets and supply chains, has arisen, and the use of big data can provide cumulative value and knowledge. With the increasing sizes and types of unstructured data on hand, it becomes necessary to make more informed decisions based on drawing meaningful inferences from the data [5]. Accordingly, [6] developed the B-DAD framework which maps big data tools and techniques, into the decision making process [6]. Such a framework is intended to enhance the quality of the decision making process in regards to dealing with big data. The first phase of the decision making process is the intelligence phase, where data which can be used to identify problems and opportunities is collected from internal and external data sources. In this phase, the sources of big data need to be identified, and the data needs to be gathered from different sources, processed, stored, and migrated to the end user. Such big data needs to be treated accordingly, so after the data sources and types of data required for the analysis are defined, the chosen data is acquired and stored in any of the big data storage. After the big data is acquired and stored, it is then organized, prepared, and processed, This is achieved across a high-speed network using ETL/ELT or big data processing tools, which have been covered in the previous sections. The next phase in the decision making process is the design phase, where possible courses of action are developed and analyzed through a conceptualization, or a representative model of the problem. The framework divides this phase into three steps, model planning, data analytics, and analyzing. Here, a model for data analytics, is selected and planned, and then applied, and finally analyzed. Consequently, the following phase in the decision making process is the choice phase, where methods are used to evaluate the impacts of the proposed solutions, or courses of action, from the design phase. Finally, the last phase in the decision making process is the implementation phase, where the proposed solution from the previous phase is implemented [6]. As the amount of big data continues to exponentially grow, organizations throughout the different sectors are becoming more interested in how to manage and analyze such data. Thus, they are rushing to seize the opportunities offered by big data, and gain the most benefit and insight possible, consequently adopting big data analytics in order to unlock economic value and make better and faster decisions. Therefore, organizations are turning towards big data analytics in order to analyze huge amounts of data faster, and reveal previously unseen patterns, sentiments, and customer intelligence. According to Manyika et al.'s research, big data can enable companies to create new products and services, enhance existing ones, as well as invent entirely new business models. Such benefits can be gained by applying big data analytics in different areas, such as customer intelligence, supply chain intelligence, performance, quality and risk management and fraud detection [7].

VI. Types of big data analytics

Here are 5 types of big data analytics:

Prescriptive Analytics

The most valuable and most underused big data analytics technique, prescriptive analytics gives you a laser-like focus to answer a specific question. It helps to determine the best solution among a variety of choices, given the known parameters and suggests options for how to take advantage of a future opportunity or mitigate a future risk. It can also illustrate the implications of each decision to improve decision-making. Examples of prescriptive analytics for customer retention include next best action and next best offer analysis.

- Forward looking
- Focused on optimal decisions for future situations
- Simple rules to complex models that are applied on an automated or programmatic basis
- Discrete prediction of individual data set members based on similarities and differences
- Optimization and decision rules for future events

Diagnostic Analytics

Data scientists turn to this technique when trying to determine why something happened. It is useful when researching leading churn indicators and usage trends amongst your most loyal customers. Examples of diagnostic analytics include churn reason analysis and customer health score analysis. Key points:

- Backward looking
- Focused on causal relationships and sequences
- Relative ranking of dimensions/variable based on inferred explanatory power)
- Target/dependent variable with independent variables/dimensions
- Includes both frequentist and Bayesian causal inferential analyses

Descriptive Analytics

This technique is the most time-intensive and often produces the least value; however, it is useful for uncovering patterns within a certain segment of customers. Descriptive analytics provide insight into what has happened historically and will provide you with trends to dig into in more detail. Examples of descriptive analytics include summary statistics, clustering and association rules used in market basket analysis. Key points:

- Backward looking
- Focused on descriptions and comparisons
- Pattern detection and descriptions
- MECE (mutually exclusive and collectively exhaustive) categorization
- Category development based on similarities and differences (segmentation)

Predictive Analytics

The most commonly used technique; predictive analytics use models to forecast what might happen in specific scenarios. Examples of predictive analytics include next best offers, churn risk and renewal risk analysis.

- Forward looking
- Focused on non-discrete predictions of future states, relationship, and patterns
- Description of prediction result set probability distributions and likelihoods
- Model application
- Non-discrete forecasting (forecasts communicated in probability distributions)

Outcome Analytics

Also referred to as consumption analytics, this technique provides insight into customer behavior that drives specific outcomes. This analysis is meant to help you know your customers better and learn how they are interacting with your products and services.

- Backward looking, Real-time and Forward looking
- Focused on consumption patterns and associated business outcomes
- Description of usage thresholds
- Model application

The Implication

As you can see there are a lot of different approaches to harness big data and add context to data that will help you deliver customer success, while lowering your cost to serve. Demystify big data and you can effectively communicate with your IT department to convert complex datasets into actionable insights. It is important to approach any big data analytics project with answers to these questions:

1. What is the goal, business problem, who are the stakeholders and what is the value of solving the problem?
2. What questions are you trying to answer?
3. What are the deliverables?
4. What will you do with the insights?

VII. Advantages of Big Data & BI

- One of the biggest advantages of Big Data is predictive analysis. Big Data analytics tools can predict outcomes accurately, thereby, allowing businesses and organizations to make better decisions, while simultaneously optimizing their operational efficiencies and reducing risks.
- By harnessing data from social media platforms using Big Data analytics tools, businesses around the world are streamlining their digital marketing strategies to enhance the overall consumer experience. Big Data provides insights into the customer pain points and allows companies to improve upon their products and services.
- Being accurate, Big Data combines relevant data from multiple sources to produce highly actionable insights. Almost 43% of companies lack the necessary tools to filter out irrelevant data, which eventually costs them millions of dollars to hash out useful data from the bulk. Big Data tools can help reduce this, saving you both time and money.
- Big Data analytics could help companies generate more sales leads which would naturally mean a boost in revenue. Businesses are using Big Data analytics tools to understand how well their products/services are doing in the market and how the customers are responding to them. Thus, they can understand better where to invest their time and money.
- With Big Data insights, you can always stay a step ahead of your competitors. You can screen the market to know what kind of promotions and offers your rivals are providing, and then you can come up with better

offers for your customers. Also, Big Data insights allow you to learn customer behaviour to understand the customer trends and provide a highly 'personalized' experience to them.

Benefits of BI

Today's companies such as Google, Amazon.com, Apple, and even Walmart and Target increasingly rely on BI to achieve a competitive advantage. Companies make use of the huge amount of information available to them and maximize the use of their data assets [2]. In the military domain, a good BI product with accurate data warehouse allows the commander to quickly select the best people for the appropriate mission. Dashboards and other visualization tools are employed by producers, retailers, and other companies. Several analytical tools are used to assist and facilitate decision making whatever the user level is. A successful BI system achieves considerable benefits for the enterprise.

- Time saving
- Single version of truth
- Improved strategies and plans
- Improved tactical decisions
- More efficient processes
- Cost savings

Additional benefits include the ability of BI systems to provide accurate information when needed, including real-time performance analysis support decision making for strategic planning [1].

VIII. Applications of Big Data

Let's look at some industries that uses Big Data:

1) Healthcare

Big Data has already started to create a huge difference in the healthcare sector. With the help of predictive analytics, medical professionals and HCPs are now able to provide personalized healthcare services to individual patients. Apart from that, fitness wearables, telemedicine, remote monitoring – all powered by Big Data and AI – are helping change lives for the better.

2) Academia

Big Data is also helping enhance education today. Education is no more limited to the physical bounds of the classroom – there are numerous online educational courses to learn from. Academic institutions are investing in digital courses powered by Big Data technologies to aid the all-round development of budding learners.

3) Banking

The banking sector relies on Big Data for fraud detection. Big Data tools can efficiently detect fraudulent acts in real-time such as misuse of credit/debit cards, archival of inspection tracks, faulty alteration in customer stats, etc.

4) Manufacturing

In the manufacturing sector, Big data helps create a transparent infrastructure, thereby, predicting uncertainties and incompetencies that can affect the business adversely.

5) IT

One of the largest users of Big Data, IT companies around the world are using Big Data to optimize their functioning, enhance employee productivity, and minimize risks in business operations. By combining Big Data technologies with ML and AI, the IT sector is continually powering innovation to find solutions even for the most complex of problems.

IX. Conclusion

In this paper, we have examined the big data, which has recently gained lots of interest due to its perceived unprecedented opportunities and benefits. In the information era we are currently living in, voluminous varieties of high velocity data are being produced daily, and within them lay intrinsic details and patterns of hidden knowledge which should be extracted and utilized. Hence, big data analytics can be applied to leverage business change and enhance decision making, by applying advanced analytic techniques on big data, and revealing hidden insights and valuable knowledge. We believe that big data analytics is of great significance in this era of data overflow, and can provide unforeseen insights and benefits to decision makers in various

areas. If properly exploited and applied, big data analytics has the potential to provide a basis for advancements, on the scientific, technological, and humanitarian levels.

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