A Review of Big Data Analytics for Organizational Business Intelligence

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Abstract: *The phrase "big data" was considered the big buzzword of 2013. Big data (BD) can be described as real-time information, media data in nontraditional form, IT-driven data, social media, and huge volume data [1].The "5 Vs" that characterize it (volume, velocity, veracity, value, and variety) are responsible for the fact that it exceeds an organization's own data as well as its storage or computes capacity for accurate and timely decision-making [2], [3]. Big data insinuate different aspects of everyday life (personal or professional) which is available in a digital form, e.g., personal or company profiles, social network, blog postings, buying histories, or health records. Nowadays, tools and techniques referred to as Big Data Analytics (BDA) are available for evaluating and analyzing all that data. Organizations have started to realize the massive effects of big data analytics on business and how it can positively impact commerce, advertising, and business intelligence (BI). Although there has been a noticeable growth in research on big data analytics, however, its capabilities and how organizations can realize its benefits completely are not well studied [4]. As an effort in this field, this study provides a review on Big data analytics for organizational business intelligence, its benefits, and challenges.*

Keywords: Big Data (BD), Big Data Analytics (BDA), Business Intelligence (BI).

1. Introduction

The importance of digital data has grown steadily since the beginning of the digital age, mainly in the business sector. Digital data has grown massively in size over time and due to technological advancement and can now be transported more easily. Furthermore, Web 2.0 technology is considered one of the major drivers that have led to big data as it increased both automatic and human production of data [3].

Business intelligence and analytics havebecome a significant interest within information systems research. There has been a noticeable growth in research on Big data analytics, however,its capabilities and how organizations can realize its benefits completely are not well studied[4].Niu et al. [5] stated that there is a shortage in research studying the operational effects of using big data analysis for business intelligence.

As an effort in this field, this study provides a review on Big data analytics for organizational business intelligence, its benefits, and challenges. The rest of the paper is organized as follows. Section 2 Literature Review. Section 3 Applications of BDA. Section 4 presents the benefits of BDA for business intelligence. Section 5 presents the challenges of BDA for business intelligence. Finally, section 6 concludes the paper.

2. Literature Review

2.1 Big Data (BD)

Goes [6]defines big data as huge volumes of numerous observational data used in the decision-making process, while Schroecket al.[1]described big data (BD) as real-time information, media data nontraditional form, IT-driven data, social media, and huge volume data. As shown in Figure 1, there are five characteristics of big data which are[2]:

- *Volume:* It represents the size of the big data set.
- *Variety:* Various data come to the companies from numerous resources (internal or external).These data entries from separate resources cause variance in the data set. External data are hardly ever structural.
- *Velocity:* the speed at which big data is generated
- *Veracity:*the degree to which big data can be trusted
- *Value:* A result should be generated after all the procedures and the result should enrich the process.
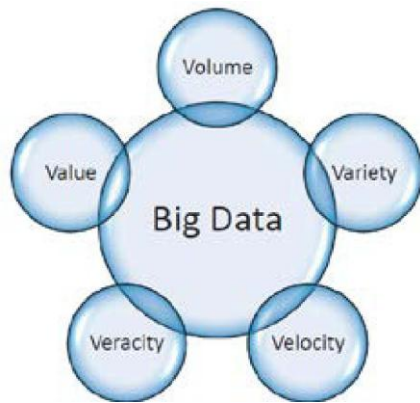
Figure 1: 5 Characteristics of Big Data [3]

2.2 Data Analytics Evolution

Data analysis has been around since the early 1950s, and it has gone through different phases of evolution. Eggert and Albers [7] summarized the characteristics of Business Intelligence and Analytics evolution in table 1 below:

Table 1: Business Intelligence and Analytics evolution [7]

Business Intelligence and Analytics evolution		
BI and Analytics 1.0 (from the early 1970s)	**BI and Analytics 2.0** (from early 2000s)	**BI and Analytics 3.0** (from 2011 to present)
DBMS-based, structured content ▪ RDBMS & data warehousing ▪ ETL & OLAP ▪ Dashboards & scorecards ▪ Data Mining & statistical analysis	**Web-based, unstructured content** ▪ Information retrieval and extraction ▪ Opinion mining ▪ Web analytics and web intelligence ▪ Social media analytics ▪ Social media networks analytics ▪ Spatial, temporal analytics	**Mobile and sensor-based content** ▪ Location-aware analysis ▪ Person-centered analysis ▪ Context-relevant analysis ▪ Mobile visualization &human-computer interaction

2.3 Big Data Analytics (BDA)

Some researchersrefer to Big data analytics as the "fourth paradigm of science",or the "new paradigm of knowledge assets"[8].Big Data Analytics is a large-scale analysis and processing of information, encompassing data sets that go beyond the capacity of conventional databases [9].Emerging big data technology has become mainstream and adopted broadly across industries, organizations, and geographic regions and among individuals to facilitate data-driven decision making for business and individual's hedonism [10].BDA includes inspecting, cleaning, transforming, and modeling data to discover and communicate useful information and patterns, suggest conclusions, and support decision making, however, by using BD data sets [11].

There are three BDA analytical categories: (1) descriptive, which deals with straightforward questions regarding what is or has happened and whywith 'opportunities and problems' using descriptive statistics such as historical insights; (2) predictive, which deals with questions such as what will or is likely to happen, by exploringdata patterns with relatively complex statistics, simulation, and machine-learningalgorithms; and (3) prescriptive, which deals with questions regarding whatshould be happening and how to influence it, using complex descriptive and predictive analytics with mathematical optimization, simulation, and machine-learning algorithms [4].

Sun et al. [10] indicate that the technological components of big data analytics are; big data, data analytics, data warehouse, data mining, statistical modeling, machine learning, visualization, and optimization. Big data and its emerging technologies including big data analytics have been not only making big changes in the way e-commerce and e-services operate but also making traditional data analytics and business analytics bring big new opportunities for academia and organizations[12]. Big data analytics tools can enable organizations to leverage big data to enhance customer loyalty, control the supply chain risk, build strategic intelligence, conduct credible market research. For example; a retailer has efficiently leveraged big data and was able to take advantage of accurate customer data, which helped expand their customer base over their competitors and increase their profit margins by 64% [5].

2.4 Business Intelligence (BI) and Big Data Analytics (BDA)

Business Intelligence can be definedas a set of theories, methodologies, architectures, systems, and technologies that support business decision-making with valuable data, information, and knowledge [10]. To differentiate between Business Intelligence and Business Analytics; the latter uses past data to extract insights to drive customer requirements and increase productivity, while BI uses both current and historical data [5]. Formerly, the data warehouse was the base of business intelligence for many years. A data warehouse is traditionally understood as being a separate database from operational systems which is built via an ETL process extracting, transforming, and loading data from the various sources into the warehouse, where online analytical processing (such as planning and reporting, ad hoc querying, spreadsheet, and dashboard as well as data mining applications) takes place [3]. Nowadays, BDA is considered a portion of BI because it helps business decision-making with valuable data. Also, BI and big data analytics share some common tools to support the business decision-making [12].

To accommodate big data requirements, Vossen [3] proposed an extended approach to traditional data warehouse

architecture. The author also claims that business intelligence and analytics applications are not necessarily dependent on a data warehouse. Nowadays, there are many tools that can be implemented as add-ons to the operational systems and databases that an organization already uses.

Sabharwal and Miah [4] reviewed the literature to identify BDA capabilities and how they can be utilized by organizations. Computational intelligence techniques are used in BDA to transform raw data into information that can be used to support decision-making. Decision-making in organizations has become increasingly reliant on Big Data and analytical applications [4].

Studies in various industries have shown that the application of BDA is a key driver of organizational success. There has been a very noticeable progress of executives' acknowledgment of BDA benefits on improving the efficiency and effectiveness of their organizations [13].Shabbir et al [13] proposed and tested a model that examines the relationship between the application of big data analytics and organizational performance (OP) in small and medium enterprises (SMEs) in Pakistan. They found that BDA has a significant positive impact on OP, where an organization's elements such as data, analytical tools, knowledge management practices create value, increase efficiency, and ultimately affect the organizational performance.Niu et al. [5] proposed a framework of Optimized Data Management using Big Data Analytics (ODM-BDA) to increase the intelligent organizational effectiveness and decision-making analysis in organizations. Sun et al. [10] studied the relationship between big data analytics and BI, and how can BDA enhance BI. They stated that big data analytics can be considered a part of BI because it "supports business decision making with valuable data, information, and knowledge". Also, Both BI and big data analytics highlight valuable data, information, or knowledge. Both BI and BDA involve interactive visualization for data exploration and discovery, which implies that BI and big data analytics share some common tools to support business decision-making. Sun et al. [10] also affirmed that big data analytics is an essential part of developing BI from a technological and data viewpoint. To elaborate, from a technological view as big data analytics is a data-driven and business-oriented technique that facilitates business decision-making and then improves BI. From a data viewpoint, big data analytics depends on data analytics and big data which have become a strategic natural resource for every organization.

Generally, in order to exploit big data efficiently, an organization must develop a comprehensive big data strategy. The process begins with information gathering and planning, which may include either a SWOT analysis or a context analysis. Once a decision is made to decide on a big data project, relevant data sources must be identified, which may include a variety of in-house sources, like databases, or external sources, such as the Web. The third phase involves deciding on the technology to be used, such as a specific Hadoop implementation. Then the implementation can take place. Finally, as the system or project is in operation, periodic or ad hoc maintenance might be required [3].

1) Applications of Big Data Analytics (BDA)

The internet as well as the digital transformation have contributed to the rise of big data, which encouraged numerous organizations to use analytical tools and methods and to increasingly invest in BDA projects to reduce costs, make more precise predictions leading to better decisions, and assist in future business planning [14]. Amazon for instance was one of the first online retailersthat maintained its innovative BDA improvement and use [4]. Below are some big data analytics applications in different fields:

Big Data Analytics in Health
Healthcare data (clinical and pharmaceutical) are rapidly increasing both in size of records and coverage in population and integrating this data is a key to significant improvements in interventions and delivery.There are some issues in data integration and analysis because of the data volume, heterogeneity, and data being stored in distributed repositories with varying access capacities[15]. So, with big data analytics, the data will be centralized to get some decisions related to patient diagnostics, fast epidemic recognition, and improvement of patient management.

Big Data Analytics in e-commerce
In the past few years, internet-based technologies, e.g., cloud computing, IoT, etc., werecreatedwhich led to generating a huge amount of data,which organizations can take advantage of by analyzing this data to enhance their business strategy and open new opportunities for e-commerce improvement.Big data analytics help e-commerce organizations to use data more efficiently, drive a higher conversion rate, improve decision making,understand user behavior and interest, identify user satisfaction, and increase companies' revenues [15], [16].

Big Data Analytics in Social Networks
The social network sites like Facebook, Instagram, and Twitter generate a huge amount of data. The social media data besides computational tools become the key to critical insights into human behavior and are constantlybeing stored and processed by organizations, individuals, and governments [15].Analyzing social media data can assists organizations to obtain customers' feedback regarding their products, which can be used to modify decisions and to maintain and enhancethe business value[17].

BDA in Business, and Economic Systems
Enterprises collect huge amounts of multi-modal data, including customer transactions,inventory management, financial data, etc. As a result of analyzing such data, organizations can integrate customer preferences and profiles, enable fully integrated financial systems, and massively improve efficiencies [15].

2) Benefits of BDA for Business Intelligence

In 2018, a Thomson's study reported that the main advantages of BI were; rapid and reliable reporting, better market choice, enhanced customer service, and higher company revenues [5]. Business intelligence also helps gather essential information from a wide variety of unstructured data and convert them into actionable

information that allows organizations to make informed policy decisions and improve business efficiency and productivity [5].

The efficient application of Big Data focuses on improving understanding of various operations and procedures for transferring information [5].Big data analytics can assistin business decision-making and understanding of business objectives by analyzing current problems and future trends, creating predictive models to predict future threats and opportunities, and analyzing/optimizing business processes based on historical or current data to enhance organizational performance [10].Nowadays, big data analytics assist BI to provide insights that would allow companies to understand their customers better, improve marketing, make personalization possible and identify real-time problems and opportunities[18].

Below are examples of successful implementations of BDA in different business sectors [4]:

- Retail: using BDA for dynamic pricing to adjust product or service prices based on demand and supply, e.g. Amazon has been using dynamic pricing to change prices based on product demand.
- Hospitality: Marriott hotels use BDA to improve sales.
- Entertainment: Netflix uses BDA to retain clientele and increase sales and profits.
- Transportation: Uber uses BDA to capture Big Data from various consumers and identify the best routes to locations. 'Uber eats,' can now deliver foods in the least time possible.
- Finance: American Express has used BDA for a long time and was one of the first companies to understand the benefits of using BDA to improve business performance. Big Data is collected on the way consumers make on- and offline purchases and predictions are made as to how they will shop in the future.
- Online business: music streaming websites are increasingly popular and continue to grow in size and scope. Many streaming services (e.g., Apple Music, Spotify, Google Music) use various BDA applications to suggest new songs to consumers.

3) Challenges of BDA for Business Intelligence

Although analyzing big data introduces huge benefits in improving business intelligence in organizations and adding value, there are some challenges that organizations should address and resolve in order to implement big data analytics successfully.

One of the biggest challenges is a technical issue related to poor data quality which arises from redundant, inaccurate, and duplicate data, which increases data storage costs and makes data more difficult to access and use, and then undermines the decision-making process. As stated by Schroeck et al. [1], poor data quality or ineffective data governance is a key challenge for BDA.

Privacy and data security (e.g., names, and financial information) is another challenge for big data management in business intelligence. The collection of data might

entailthe invasion of privacy of many people. Therefore, enterprises need to follow the data privacy policies and develop some security controls to ensure that data are not used to violate the customers' personal privacy[21]. While security breaches and data misuse have always been a challenge in computer science, it reaches a new level with big data.

Big data analysis is also challenged by the lack of smart big data sources, the shortage of accessible real-time analysis capacities, and access to adequate network capacity for running apps. In addition, the need to increase network spans, data protection, and legislation on data protection, interoperability, disparate data fragmentation, and inadequate availability [5].

The deployment of Big data analytics requires costly tools and considerable computer resourcesas it includes storing huge amounts of heterogeneous cumulative data from various sources [5].

Computing and security can be an issue in terms of hardware technologies that enable big data analysis. For example; a single computer configuration cannot be made available for real-time and portable analysis, networking infrastructure issues, and the storing power of magnetic disks [5].

Finally, The challenges facing any organization deciding on implementing BDA to improve business intelligence and decision-making also include plan failure, lack of preparation, resource failure, and risk-taking capability [5].

3. Conclusion

The idea of business intelligence that was first centered on data mining as a way of describing how businesses could enhance or develop their "intelligence" regarding customers and revenues has now advanced to new levels. Increasing volumes of data available in digital form allow businesses to gain new and better insights by applying BDA, as well as permitting new discoveries in areas such as physics or health care which do not necessarily fall into the realm of "business". So big data can indeed be seen as the new intelligence enabler due to the extent of data available today and the available technology which enables organizations to perform analytics, to see connections, and to make accurate predictions.It's important to note that big data does not just require the right technology, but also needs appropriate governance and protection.

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