

Retracted: The role of big data in financial sector: A review paper**Enas Al-lozi^a, Amjed Alfityani^b, Ayman Abdalmajeed Alsmadi^{c*}, Amer Moh'd Al_Hazimeh^d and Jassim Ahmad Al-Gasawneh^e**^aDepartment of Management Information Systems, Al-Zaytoonah University of Jordan, Jordan^bApplied science private university, Faculty of business, applied science private university, Amman, Jordan^cAl Zaytoonah University of Jordan, Jordan^dAl_Bayt University, Jordan^eApplied Science Private University, Jordan**CHRONICLE****ABSTRACT***Article history:*

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In the current era of information technology Big Data has gained significant importance in almost all the industries throughout the world. Big Data is now renowned for having the capability of effective decision making. Now companies around the globe are using Big Data for market analysis, customer analysis, however, the utilization of Big Data is much higher in the financial sector, yet publications on Big Data and finance are limited because of having significant challenges. Even though utilization of Big Data is highest in the financial sector and its importance cannot be ignored, the studies and analysis are inadequate. Considering the importance of Big Data in the financial sector this paper is an attempt to conduct a comprehensive literature review in the field of Big Data and finance. Thus, the study will contribute to the body of knowledge by providing horizons for empirical research in the field of Big Data and finance.

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1. Introduction

Importance of Big Data in rational decision making is unignorable (Abkenar, Kashanib, Mahdipour, & Jameii, 2021). Decision making based on proper analysis and research gains fruitful results and this reality is well recognized in the digital era (Ain, Vaia, DeLone, & Waheed, 2019). Big Data is gaining importance day by day and is gaining the attention of the researchers as well as academicians (Salehan & Kim, 2016). The term Big Data has been developed to enhance the term data that is gathered through various sources including employees, customers, suppliers, and other stakeholders (Wolfert, Ge, Verdouw, & Bogaardt, 2017). With the passage of time and especially with technological advancements the concept is gaining attention (Liu, Soroka, Han, Jian, & Tang, 2020). With the occurrence of this phenomenon in several organizations the top management is willing to invest in Big Data projects (Dubey & Gunasekaran, 2015). However, the current infrastructure executives of the companies believe that is unable to handle the huge data sets appropriately (Alharthi, Krotov, & Bowman, 2017), moreover, technology capability, structure of the organization, capacity of the systems to process the data which is gathered from different areas is hardly handled properly (Pappas, Mikalef, Giannakos, Krogstie, & Lekakos, 2018) and many relevant and useful information that can be drawn from the available data are missed (Ferraris, Mazzoleni, Devalle, & Couturier, 2019). The issues further exceed storing of the data for a drawing inference over a longer period, and efficient management of the Big Data is insufficient (Zhuang, Wu, Chen, & Pan, 2017; Hattingh & Eybers, 2017).

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Usually, companies handle Big Data projects as separate projects (Ayankoya, Calitz, & Greyling, 2014). The handling of Big data Projects are mostly different from the way other technology projects are administered (Cato, Brumm, Gölzer, & Demmelhuber, 2016). The basic difference is that most organizations require proper preparation for such requirements as per the areas which need to be aligned for handling the complexity of the characteristics of Big Data (Phillips-Wren, Iyer, Kulkarni, & Ariyachandra, 2015). The characteristics like volume, velocity, and variety in Big Data need to be aligned as per the requirements for the purpose of implementing the systems based on requirements of the big data, only then the value can be created by the investment in Big Data projects (Kache & Seuring, 2017).

With the passage of time large businesses have realized the advantages of big data especially in financial matters. Along with several advantages there are certain costs associated with the same (Shah, Soriano, & Coutroubis, 2017). The most crucial cost is that investment in Big Data projects is supposed to be the riskiest investment because it involves a huge level of preparation by the organization conducting Big Data projects. It helps in financial forecasting and handling financial matters in a more strategic way. In the current era the companies are at crossroads, businesses are currently facing difficulties in handling the challenges and getting benefits from Big Data on one hand and on the other hand they are making efforts with Big Data challenges (Ain, Vaia, DeLone, & Waheed, 2019).

Proper Big Data handling is a system where businesses use data warehouses, online analytical processes, and dashboards in an integrated system (Sun, Shi, & Zhang, 2019). Properly managed Big Data projects facilitate clear, useful, and detailed information that is useful for in depth analysis which is helpful in multiple ways (Yoon C., 2008; Duan & Xiong, 2015). Such projects enable the decision makers through proper graphs which clearly guide them the trends and identify the key performance indicators (Ardito, 2019). Once businesses become sure that they will gain and maintain competitive advantage through the investment in Big Data they will be more than willing to invest in Big Data technology (Anwar, Khan, & Shah, 2018). The major disappointment occurs when the organization feels that their investment in Big data projects failed to meet their expectations (Tien, Ali, Miskon, Ahmad, & Abdullah, 2019).

These disappointments have several issues. The most common and highly observed issue is inability of the Big Data and analytical systems to handle and generate required reports over the Big Databases (Chehbi-Gamoura, Derrouiche, Malhotra, & Koruca, 2018). Another issue is varying results or deviation of forecasting from the actual results (He, 2014). Such issues lead to disappointment and because of low quality of the information and inability to meet the requirements of the companies negatively affect the organizational performance (Maroufkhani, Tseng, Iranmanesh, Ismail, & Khalid, 2020). The basic reason is inability of effective decision making (Smys & Joe, 2019).

Currently along with businesses even the governments are also facing challenges with handling Big Data despite the fact of having unlimited resources. To meet the challenges and get maximum benefits, the users of Big Data are trying to add new capabilities among their strategies while considering Big Data (Chen, Schütz, Kazman, & Matthes, 2017). Among several challenges one major challenge is to define Big Data as it has varied definitions (López-Robles, Rodríguez-Salvador, Gamboa-Rosales, Ramirez-Rosales, & Cobo, 2019). Despite several definitions the commonalities in definition include three basic characteristics which are data volume, data variety, and data velocity (Tella & Kadri, 2021). Comprehending all the variations there is no harm in claiming that Big Data is a term that describes the capabilities like storage of complex and huge databases with the help of advanced tools and techniques (Sharma, Tripathi, & Srivastava, 2021).

With the help of the tools and techniques mentioned above it has been observed that large firms, because of having large revenues, relatively more stable revenue streams, and having good credit repute are in dire need of Big Data projects for handling their large customer base and maintaining proper financial records (Mashingaidze & Backhouse, 2017). Large businesses for having a high level of economic activities and relatively lengthy history of the firm, produce more data, thus, require proper storing and handling of the same (Begenau, Farboodi, & Veldkamp, 2018). The importance of Big Data in large firms, therefore, has increased.

With the technological advancements the processor speeds are rising, this capability has attracted financial analysts more than other users of Big Data (Kasturi, Devi, Kiran, & VinuKiran, 2016). The current latest systems and tools enhance the forecasting capability of investors and help in minimizing the uncertainty in the stock markets along with reducing the cost of capital of the corporations. Having the capability of processing more data, investment costs of large forms has declined, which further enables them to grow further.

Considering the importance of Big Data for the large businesses in general and specifically in financial matters, the objective of this review is to understand the challenges associated with Big Data in finance in the light of the existing literature. In the upcoming section initially characteristics of Big Data have been identified to better understand the concept. Characteristics of Big Data will be followed by significance and challenges associated with Big Data in finance are mentioned in the light of existing literature. After identifying the challenges, opportunities for Big Data in finance have been discussed along with the application possibilities of Big Data in finance. The final section covers the implications of Big Data in finance for research as well as practice. The findings of the current research are significant for the organizational managers dealing with finance so that they may effectively adopt Big Data.

2. Characteristics of big data

As mentioned earlier that there is no perfect definition of Big Data, however, three dimensions were finally identified that are recognized by all definitions. The three characteristics or dimensions of data volume, data velocity and data variety are key features of Big Data (Kumar & Prabhu, 2021). Despite technological advancement a challenge that has not yet been met is overcoming the massive volume of data (Lu, 2020). The massive volume is generated at an accelerated rate termed as increasing velocity (Ghasemaghahi & Turel, 2020). This massive volume generated at an accelerated rate is gathered through a variety of different sources (Sharma, Tripathi, & Srivastava, 2021). Yin and Kaynak (2015) defined the term Big Data as a data set “whose size is beyond the ability of typical database software tools to capture, store, manage, and analyse.”

Three V's of Big Data represents the three different dimensions (Mehta & AnilPandit, 2018). First V i.e., volume refers to a huge amount of data, whereas second V i.e., velocity is the speed at which the data is generated and processed, and final V i.e., variety shows various sources. The three Vs are used by several authors and are currently grown to five V's by adding Veracity and Value (Nguyen, Zhou, Spiegler, Ieromonachou, & Lin, 2018). For better understanding of the initiation of differentiation between conventional data handling and current Big Data analytics, a pictorial view of the characteristics of big data in the current era has been shown in the Fig. 1:

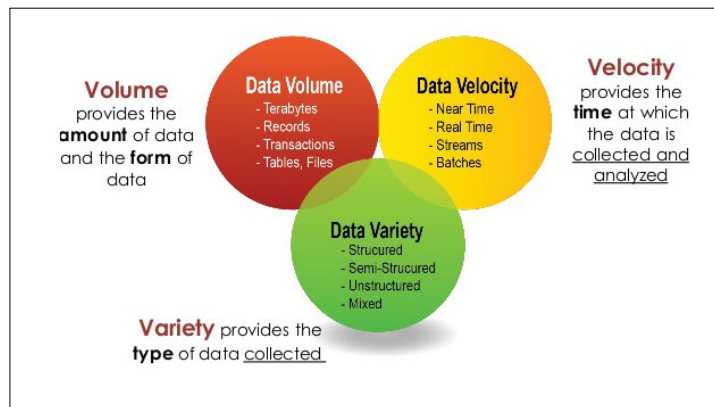


Fig. 1. The characteristic of Big Data Analytics

The three variations explained in figure 1 have been used by several authors in their studies. In the last five years the authors have discussed five dimensions of Big Data. The addition two V's of Big Data that are veracity and value where veracity shows trust or uncertainty of the Big Data that is inbuilt in the decisions taken through the analysis of Big Data. On the other hand, value represents the insight that is retrieved by the business by using Big Data. Value demands operational procedures as well as better strategies along with scalability. Thus, in the current era the most accepted characteristics of Big Data are volume, velocity, variety, veracity, and value commonly termed as 5 V's. The five Vs of Big Data are the key features that differentiate conventional data handling with current data analytics. Currently a brief picture is commonly used to represent 5 V's as mentioned in Fig. 2.



Fig. 2. Five V's of Big Data Surya Gutta (2020)

Fig. 2 represents the final main V's that are currently being utilized by the companies for considering Big Data Analytics. Big Data analytics, if utilized by companies properly.

3. Systematic Review Methodology

In the current study, the purpose was to conduct a systematic analysis of utilization of big data analytics in the field of finance. Therefore, for the said purpose of getting a better understanding initially, the literature has been reviewed in general to understand the term big data analytics along with its characteristics. Initially, big data analytics has been defined with the viewpoint of various researchers. Afterwards, the utilization of big data analytics for trend and prediction has been reviewed in the field of finance. Finally, the utilization of big data analytics in a particular field of finance has been conducted which clearly shows the utilization of big data analytics in finance in the five areas which have been mentioned in Table 3.

4. Overview of Big Data and Big Data Analytics

While discussing Big Data and Big Data analytics it's better to first understand the term Big Data. The term Big Data was first utilized by the NASA scientists in 1997, who gave the first definition of Big Data. They developed the idea for data volume which raises the challenge for computer systems for having huge memory to store Big Data, which certainly requires more resources like external storage devices and internal storage devices like disks and memory cards etc, which was considered as a big problem (Zainal, Hussin, & Nazri, 2017). Right after four years of evolution of the term META group analyst Goug Laney expanded the term by adding challenges related to expansion of the data and opportunities with the same, and summed up into three categories: volume, velocity, and variety (Esteves & Curto, 2013; Mauro, Greco, & Grimaldi, 2016) which were later expanded to five. Mentioned in Fig. 2. High volume and velocity of Big Data provides efficient innovative types of readily available information for better understanding, effective decision making, and optimization of processes (Zainal, Hussin, & Nazri, 2017). Big Data analytics helps in structuring the unstructured data. Big Data is a wide range of concepts; it covers collection, aggregation, transformation, derivation for understanding human behavioural patterns (Favaretto, Clercq, Schneble, & Elger, 2020). The concept of Big Data is to deal with massive data with large structures (Akoka, Comyn-Wattiau, & Laoufi, 2017). The basic difference between conventional data management and Big Data is the processing capabilities (Al-Sai, Abdullah, & Husin, 2020). Considering the different definitions precisely it can be said that Big Data is "large volume of high velocity, complex and variable data that require advanced techniques and technologies to enable the capture, storage, distribution, management, and analysis of the information".

5. Big Data Analytics

Utilizing Big Data insight provided financial benefits in terms of cost cutting or improvement in productivity. At the same time, it also opens the horizons of new business opportunities. New business opportunities are based on the decisions which are dependent on the analysis of Big Data and certainly are more effective decisions. By using Big Data Analytics, the prevailing old data is processed using advanced tools for the purpose of assessing the huge volume of structured, unstructured, and semi-structured data that is gathered from similar sources (Asad, Altaf, Israr, & Khan, 2020). For reaching real-time decision making the major challenge that currently the businesses are facing is developing trends based on historical data and accessing real-time data. This is done for the purpose of knowledge discovery and making more effective decisions based on Big Data analytics (Shabbir & Gardezi, 2020). In the last two decades Big Data analytics has emerged as a new technological paradigm. This technological paradigm shift helps to understand the valuable insights and associations among the variables. Because of the capacity of efficient and effective decision-making Big Data Analytics has shifted several businesses to forecast-based business decision making instead of using structural stored, regular, correlated databases. Big Data analytics assists businesses to gain competitive advantage over their peers because of becoming capable of enhancing business performance. This capability of Big Data analytics also helps businesses to achieve optimization in decision making (Bag, Wood, Xu, Dhamija, & Kayikci, 2020). This entire process of extracting the right information from the huge volume of data that continues to receive that a great velocity through variant sources, that is useful for the decision making is termed as big data volume chain which is a continuous process that continuously guides the businesses for taking effective decisions with every changing business environment and customer preferences (Amir & Asad, 2018; Mikalef, Boura, Lekakos, & Krogstie, 2019). The term Big Data Analytics covers the analysis of time series data that is usually stored in the data warehouses along with the real-time data which is being collected at an accelerated rate (Osman, 2019). Mostly the data sets are collected through the smart city information services which provided data from various domains (Alahakoon, et al., 2020) and the data is processed through the mechanism of big data volume chain (Alam, Khan, Gharaibeh, & Gharaibeh, 2021). In order to better understand the term big data analytics and its advantages Table 1 clarifies the term used by different authors along with its advantages.

Currently Big Data analytics covers every way through which the data can be collected like call logs, frequently visited websites, content that is generated through online users, search engines like Google, images which are convertible into structured, valuable, information with the help of computational and statistical techniques. All these databases are used to understand and identify the trends and patterns. The framework of Big Data Analytics is a methodology which is implemented by extracting, transforming, loading, and analysing data based on historical trends (Abkenar, Khashanib, Mahdipour, & Jameii, 2021). The most important feature or the most efficient software now extracts the outliers and helps in discovering the hidden patterns which are apparently unobservable. This technique is also referred to as intelligence and utilizing this strategic component to gain competitive advantage.

Table 1
The Definition of Big Data Analytics

Authors	Definitions
(Abkenar, Kashanib, Mahdipour, & Jameii, 2021)	Big data analytics are techniques and frameworks categorized in contextual and network approaches that helps in firm growth.
(Akoka, Comyn-Wattiau, & Laoufi, 2017)	Big data is massive data with large structures that identify the data flow while relying on data flow using IT functions to improve the value of firm
(Al-Sai, Abdullah, & Husin, 2020)	Big data is an asset that has attracted the attention of the top management to gain foster insight and high revenue
(Asad, Altaf, Israr, & Khan, 2020)	Big data analytics is a term that can help the businesses regardless of size, if appropriately utilized for decision making and drawing inferences through the use of appropriate techniques
(Bag, Wood, Xu, Dhamija, & Kayikci, 2020)	Five dimensions of big data namely; volume, veracity, variety, velocity, and value help in gaining competitive advantage
(Dong & Yang, 2020)	Big data analytics having marketing capabilities drives the organizations towards market-oriented innovations using social media trends
(Favaretto, Clercq, Schneble, & Elger, 2020)	Big data analytics describes a wide range of concepts from collecting and aggregating huge data sets to an understandable usable manner for identifying human behavior
(Mauro, Greco, & Grimaldi, 2016)	Big data analytics is characterized by high volume, velocity, and variety used with specific technology to retrieve specific information
(Pappas, Mikalef, Giannakos, Krogstie, & Lekakos, 2018)	Big data analytics has the capability to portrait business analytics eco-system towards digital transformation and sustainability in performance

6. Predictive Analysis

For gaining competitive advantage, timely decision making based on Big Data in business and service domain is a key factor. Majority of the businesses in the world consider competitive advantage as the prime advantage of using data analysis for forecasting. The business related to banks at the top for using predictive analysis using Big Data analytics for credit cards, credit history, financing mode, and other investment opportunities (Patil, Nemade, & Soni, 2018). For making quality decisions most of the big businesses use data applications to get reliable and quick data for timely use.

Predictive analysis is the most used term for utilization of time series data for understanding behavioural patterns and trend analysis. In the current world, there is no harm in saying that those businesses perform better among peers that compete on the capabilities of data analytics and use the same while following fact-based management approaches (Bumblauskas, Gemmill, Igou, & Anzengruber, 2017). To follow the approach of analytic driven business, the organizations need to learn on a continuous basis. The learning and adaptive capabilities can give the advantage by focusing on real time data driven business. In the current era, certain specific forms of analytics are being implemented by the businesses which are termed as advanced analytics. This advanced analytics is a combination of different techniques and tools. These tools are predictive analytics, commonly used with the help of statistical software. The accuracy of the predictive technique is dependent on the capability of the technique in becoming closer to actual as is predicted. Table 2 mentioned below identifies the studies that have been conducted regarding utilization of big data analytics for forecasting and identifying the trends.

Table 2
Big Data Utilization

Big Data Utilization	Description	Source
Predictive Business Analysis	Big data has always been utilized even before the evolution of predictive big data, as in case of stock markets and for the prediction of business trends, sales forecasting, and risk prediction	(Liu, 2015; Patil, Nemade, & Soni, 2018; Salehan & Kim, 2016; Song & Song, 2021)
Trend in Big Data Analytics	There are a very few key studies that have been mentioned regarding the trends in the big data. Big data analytics is equally utilized for prediction as well as identifying the past trends in the business for understanding different patterns	(Sharma, Tripathi, & Srivastava, 2021; Tang, Luo, & Zhang, 2019; Sharma, Tripathi, & Srivastava, 2021; Yin & Kaynak, 2015)

7. Significance of Big Data in Finance

Alsmadi et al. (2019, 2022) mentioned that in the digital era, Big Data has significantly changed and transformed the way of living and thinking. Currently, any investor either business or individual takes the decisions based on data trends and forecasting techniques (Wamba, et al., 2017). While doing investment in the financial sector everyone either business or individual decides based on some sort of analysis (Aker, Wamba, Gunasekaran, Dubey, & Childe, 2016). Likewise, the corporate sector for the purpose of enhancing performance through the efficient management of available funds use the technique for efficient management of the working capital (Asad, 2011). Financial sector dominated by the banking sector is investing a lot in Big Data analytics (Power, Heavin, McDermott, & Daly, 2018). The banking sector generates huge data including customer data, financial products data, transactions data etc. All that data is used for assisting the decision support systems by linking it with the external data generated from social media or marketing websites (Saleem, Yongjun, Ali, Mehreen, & Mansoor, 2020). To gain competitive advantage now a day's majority of the banks use Big Data which is relevant for their business (Assis, et al., 2019). The trend is continuously increasing for the usage of Big Data analytics because it has now become a must for survival in the competitive era (George, Martine, & Pentland, 2014). Financial sector is currently using applications that cover social media, websites, management of risk, security intelligence, and even fraud detection or fraud risk assessment (Liu, 2015). The

most used tracks for extracting information are text mining (Bach, Krstić, Seljan, & Turulja, 2019). The core aim of Data mining through emails, reports and official documents is to draw different kinds of information to be used in varied decision making by following the trends (Sowmya & Suneetha, 2017). The data is primarily organized in such a way that it can be analysed qualitatively or quantitatively (Babar, et al., 2020). Financial data drawn through such resources helps businesses to categorize them as per the need of business problem for proper investigation (Fang & Zhang, 2016). The core goal is to understand the patterns. The usage of Big Data at banking can be understood from the study conducted by Trelewicz (2017) and as shown in the Fig. 3:

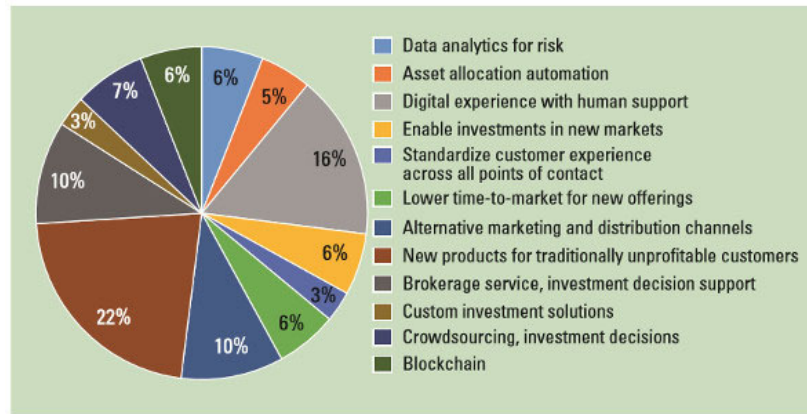


Fig. 3. Big Data Usage in Banking Sector

The above figure clearly shows that Big Data is handled by the banks covering all the aspects. Moreover, companies involved in the business of financial technology design customized systems and products for the banking industry according to the specifications of their needs (Sun, Strang, & Firmin, 2017). Financial data and the information obtained with the processing of such data require a lot more research for the development of appropriate algorithms to get maximum out of it (Chiang, Grover, Liang, & Zhang, 2018). Appropriate decision making over the financial matters is compulsory for increasing effectiveness of the business (Whitelock, 2018). Research conducted over the published research between 2000 to 2016 identified that by focusing on cyber security and use of mining applications in finance enhances the financial decision based on knowledge-based systems (Kumar & Ravi, 2016).

8. Big Data in Finance

Currently, use of Big Data, to distinguish the providers of financial services based on advanced analytics is in continuous increase. Along with the advantages like improvement in customer services, operational efficiency, and effectiveness, managing Big data also helps in cost reduction with advanced technology.

Table 3

Utilization of Big Data in Finance

Application Areas	Description	Studies
Big Data in Financial Sector	The use of big data analytics in financial sector is historical as it has always been used in the stock prediction. Financial sector is perhaps the largest user of big data analytics and its utilization is increasing continuously.	(Bach, Krstić, Seljan, & Turulja, 2019; Bukovina, 2016; Hasan, Popp, & Oláh, 2020; Subrahmanyam, 2019; Sun, et al., 2020; Tang, Luo, & Zhang, 2019; Trelewicz, 2017)
Big Data Analytics in Banking Sector	Being a major component of financial sector banking sector, itself is a main user of big data analytics, banking sector not only use big data analytics for financial forecasting but for trend analysis, risk analysis and customer analysis as well.	(Giebe, Hammerström, & Zwerenz, 2019; Li, Chen, & Liao, 2020; Patil, Nemade, & Soni, 2018)
Big Data Analytics and Firm Performance	The firms regardless of the level of the firm when take decisions regarding marketing, production, and sales on the basis of big data analytics gain competitive advantage and as a result there performance enhances	(Begenau, Farboodi, & Veldkamp, 2018; Chang, McAleer, & Wong, 2018; Kasturi, Devi, Kiran, & VinuKiran, 2016; Kumar & Ravi, 2016)
Big Data Analytics in Accounting and Finance	Businesses are now using big data for accounting, finance, and audit purposes. Utilization of big data in audit department and accounting department has helped businesses to improve efficiency and performance for the gaining better results in their operational activities. However, there are several challenges that businesses are facing while implementing big data analytics in their operations.	(Bhimani & Willcocks, 2014; Chen, Tao, Wang, & Chen, 2015; López-Robles, Rodríguez-Salvador, Gamboa-Rosales, Ramirez-Rosales, & Cobo, 2019; Russell, 2018; Yoon, Hoogduin, & Zhang, 2015; Whitelock, 2018)

The data available from the financial sector like online banking transaction, mobile apps data, asset management, management of trading online, online lending etc. helps the financial sector in improving performance and taking the right decisions based on the trends and customer demand. Services like online banking transactions, mobile apps, asset management, management of trading, and online lending provide millions of pieces daily. Covering the domain of banking transactions several authors have addressed and explained various relationships that they have developed based on data analysis gathered through online

sources. Dissemination of data and the volume of data shows efficiency of financial markets. Furthermore, the role social media plays in financial market performance cannot be ignored because in developing countries financial markets are highly rumours based rather than depending on the fundamentals. As discussed above that data is huge that is generated through online transactions which require efficient management and can be utilized for optimization of operations (Dong & Yang, 2020). Through optimization techniques return on investment and return on equity can be increased. Big Data in finance is equally important as in the field of marketing or human resource. The stock markets anywhere in the world follow technical analysis as compared to fundamental analysis. Thus, the importance of Big Data in the field of finance cannot be underestimated. For further understanding table 3 identifies the utilization of big data in the field of finance from various perspectives.

9. Challenges of Big Data in Finance

From the above discussion it is obvious that the importance of Big Data and Data analytics if ignored by any business will certainly affect its business performance (Maroufkhani, Wagner, Ismail, Baroto, & Nourani, 2019). Big data in the current society provides several opportunities, however, the challenges are also associated with the same (Zhong, Newman, Huang, & Lan, 2016). The massive sample size along with the huge number of dimensions in Big Data create several challenges in its management (Jin, Wah, Cheng, & Wang, 2015). Complexity in the data is a major issue (Hasan, Popp, & Oláh, 2020). The major challenges include scalability, noise, fake relationships, storage bottleneck, and mistakes in measurement (Fan, Han, & Liu, 2014). The reason behind these mistakes and challenges is that Big Data is not gathered in vacuum, rather gathered through some other activity with different objectives. Another issue is to define the application of filters so that any important data is not discarded. Likewise, the available data is usually not in the readily usable form. Zhong, Newman, Huang, and Lan (2016) identified that method of data collection, technologies available for fast growing Big Data, use of latest decision-making models, interpretation and applications are the major challenges.

The term Big data which refers to abundance is a collection of varied data sets. The complexity creates challenges while handling Big Data using traditional approaches (Yin & Kaynak, 2015). The complexity in the financial data because financial websites are affected not only because of the fundamentals of the companies, however several other factors influence the same (Sheikh, Asad, Israr, Tabash, & Ahmed, 2020). Considering the challenges Jin, Wah, Cheng, and Wang (2015) highlighted that major challenges in handling Big Data in finance are complexity of the data, complexity in computation and complexity in the systems to understand for a lay man.

The issue of unreliable data should not be ignored, the errors in data may be because of human biases, or fault in sensor, or website issue. While gathering the data, the assumptions that were used while storing the data should not be ignored. While handling Big Data the most critical thing is understanding, human beings can understand various meanings of the same words or can even understand the gestures, however, when the machine analysis algorithm is used it accepts only homogenous data (Hariri, Fredericks, & Bowers, 2019). Along with the issue of homogeneity, another issue is related to incompleteness and inconsistency, because the data is gathered through various sources and has the issue of varying reliability. Handling the missing values, errors, and uncertainties creates another challenge (Yaseen, S.G., & Qirem, I.A. 2018).

As mentioned earlier that size of the data is a challenge which is somehow catered by high-speed systems, however, in the current time the pace is even faster and due to the same reason filtering and sorting on real-time basis has become a major hurdle, because of fast pace the variation is also very rapid (Song & Song, 2021). The best example in this case is the stock market, if one misses some event the one may face a severe loss (Trelewicz, 2017). Due to the internet the security and ownership of the data is another issue, even the privacy of the consumer has been challenged which the companies are supposed to manage (Jagadish, et al., 2014).

Sowmya and Suneetha (2017) identified that while capturing and executing short and simple queries, the required infrastructure should support Big Data acquisition in a low and predictable latency. Sun, Shi, and Zhang (2019) argued that organizing and managing financial Big Data in effective and efficient ways is a major challenge. Likewise, developing a sound business model with the help of Financial Big Data is of the same difficulty. Managing issues like high trading volume, sentimental issues of investors, credit risk, and risk of financial analysis variability are among the top risks facing the financial managers today (Yoon, Hoogduin, & Zhang, 2015). One of the topmost issues with financial websites is safety and security of systems, in terms of protecting them regarding security of individual clients. Several researchers argued and supported the argument that use of Big Data analytics in the financial sector creates competitive advantage, however, converting challenge into opportunity itself is a big challenge, in other words getting competitive advantage with the help of Big data itself is challenging (Sun, et al., 2020). The inherent challenge of Big Data Analytics is its usability by the finance sector because strengthening financial innovation requires expertise of individuals in finance as well as IT and traditional bankers are reluctant in its adoption (Li, Chen, & Liao, 2020).

Considering the major challenges associated with the implementation of Big Data and handling Big Data, it can be observed that Big Data analytics is not only an opportunity or just benefits, however, there are challenges associated with it. If the challenges are not properly catered or overcome, chances are very high that the organization may face big challenges and end up with Big Data as a huge cost for the organization rather than getting competitive advantage or cost saving (Harford, 2014).

10. Implications for Research and Practice

The purpose of the review paper was to understand the research development in the field of Big Data especially in the domain of finance. A comprehensive literature review in the field of Big Data and Data analytics. After identifying the key issues that have been faced in the last two decades since the arrival of the concept of Big Data, this review paper has identified the following implication for research and practice. After reviewing the characteristics and challenges of Big Data it is recommended that the current challenges require further research for the development of the latest computational and statistical paradigm (Columba, Gambacorta, & Mistrulli, 2010). There is a need to further develop even more safe systems in the field of finance to ensure safety to its users (Tian, Han, Wang, Lu, & Zhan, 2015; Woodard, 2016). Another issue especially regarding finance is that many times the predictive models have validity issues (Bhimani & Willcocks, 2014). The incorrect statistical inferences and consequently wrong scientific conclusions lead to major disasters and cause major losses to the corporation, due to which some organizations consider that investment in Big Data as a cost rather than advantage (Constantiou & Kallinikos, 2015). In continuation with the same issue a major challenge is understanding of the models, as many times assumptions of the models are ignored which is a major challenge (Jin, Wah, Cheng, & Wang, 2015). Many times, erroneous results are computed due to lack of understanding or inability of the users in understandability of the model (Tang, Luo, & Zhang, 2019). At times the computations are also incorrect due to cleaning techniques used because many important information is trimmed and cause a failure of the predictive model (Russell, 2018). Therefore, it is suggested that while cleaning the data carefully structured steps should be taken. A major issue as discussed lies with the collection method or trimming, which needs to cater to the use of appropriate sensors, especially regarding the financial records, the inherent noise should not affect the real crux of the data (Yang, Chen, Shi, & Wen, 2018). Any inconsistency should be catered, and the assumptions should clearly be identified so that the users of the financial modelling may not seek any misleading results (Giebe, Hammerström, & Zwerenz, 2019). The inbuilt uncertainty, speed, variety, and lack of confidence should be removed by the provision of more reliable results (Hariri, Fredericks, & Bowers, 2019). While obtaining results and making decisions the users should use artificial intelligence techniques rather than using conventional data handling platforms (Chang, McAleer, & Wong, 2018). Finally, it would be right to say that considering the financial issues in Big Data, there is a need for further research in the field, the research should focus on developing even more reliable models (Mihet & Philippon, 2019). The models should be developed with minimum assumptions and their applicability should be flexible as per the situational analysis, more specifically, the financial markets, the management of funds and financial decision making can be competitive if appropriately used (Bukovina, 2016). There is a need to develop connections between financial components and Big Data (Chen, Tao, Wang, & Chen, 2015). As identified by Hasan, Popp, and Oláh (2020) that Big Data is a newly introduced concept in the field of finance, therefore, there is a significant need for studies in the field of financial risk management and modelling for financial instruments. Thus, the current research argues that research in Big Data should follow the same academic standards similar to the rest of the finance related literature. Subrahmanyam (2019) argued that only by the use of rigorous standards financial practitioners can be advised on the basis of Big Data.

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