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Big Data in Finance

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ABSTRACT

Big data refers to extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions. It is a term used to describe the large and complex datasets that are generated by businesses, organizations, and individuals. Big data in finance refers to large, diverse (structured and unstructured) and complex sets of data that can be used to provide solutions to long-standing business challenges for financial services and banking companies around the world. Big data analytics is transforming financial services by enabling institutions to analyze vast datasets, identify patterns, and make more informed decisions. Businesses across industries are using this technology for a wide range of purposes, including fraud detection, predictive analysis, and market research. Financial institutions leverage big data to personalize services, offer tailored products, and predict future outcomes. This paper seeks to explore the current landscape of big data in banking and other financial services.

KEYWORDS: *big data, big data analytics, finance, banking, financial services*

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INTRODUCTION

The financial services industry is made up of banks, credit unions, insurance companies, wealth management companies, and credit card companies just to name a few. Community-based financial institutions, such as credit unions and cooperatives, frequently cater to local communities by offering financial services to individuals who may lack access to traditional commercial banks. Historically, financial institutions have been collecting data in the form of addresses, names, and demographic data from credit cards, loan applications, and bank accounts. Traditionally, number crunching was done by humans, and decisions were made based on inferences drawn from calculated risks and trends. However, in recent times, such functionality is usurped by computers. The exponential growth of computer technology and increasing data generation are fundamentally transforming the way industries and individual businesses are operating.

Big data comes from both internal and external sources and is collected in different ways. Internal sources of big data include invoices, payments, delivery receipts, storage, demographic data, and sensor data, while external sources include social media, data from government agencies, and search engine data. Big data opens up a wealth of opportunities for businesses. It empowers companies to enhance decision-making processes, design personalized products or services, deliver superior customer service, make accurate predictions, and identify fraudulent activities. Big data in the financial services industry can help businesses gain insights into customer behavior, optimize operations, and create new opportunities for growth. It is a powerful tool that can help companies make more informed decisions and gain competitive advantages. Big data technologies are instrumental in making the financial industry strengthen their efficiencies, protect their companies, and provide better service to their customers [1].

In the age of technological innovation, various types of data are available with the advance of information technologies, and data is seen as one of the most valuable commodities in managing automation systems. Big data is an emerging issue in almost all areas of business. Big data technology has become an

integral part of the financial services industry and will continue to drive future innovation. It effects a variety of facility, such as financial management, risk management, financial analysis, and managing the data of financial applications. Big data in finance refers to the petabytes of organized and unstructured data that may be utilized by banks and financial institutions to predict client behavior and develop strategies. Financial institutions are not digital natives and have had to go through a lengthy conversion process that necessitated behavioral and technological changes.

WHAT IS BIG DATA?

Big data applies to data sets of extreme size (e.g. exabytes, zettabytes) which are beyond the capability of the commonly used software tools. It involves situation where very large data sets are big in volume, velocity, veracity, and variability [2]. The data is too big, too fast, or does not fit the regular database architecture. It may require different strategies and tools for profiling, measurement, assessment, and processing. Different components of big data are shown in Figure 1 [3].

Big Data is essentially classified into three types [4]:

- *Structured Data:* This is highly organized and is the easiest to work with. Any data that can be stored, accessed, and processed in the form of fixed format is known as a structured data. It may be stored in tabular format. Due to their nature, it is easy for programs to sort through and collect data. Structured data has quantitative data such as age, contact, address, billing, expenses, credit card numbers, etc. Data that is stored in a relational database management system is an example of structured data.
- *Unstructured Data:* This refers to unorganized data such as video files, log files, audio files, and image files. Any data with unknown form or the structure is classified as unstructured data. Almost everything generated by a computer is unstructured data. It takes a lot of time and effort required to make unstructured data readable. Examples of unstructured data include Metadata, Twitter tweets, and other social media posts.
- *Semi-structured Data:* This falls somewhere between structured data and unstructured data, i.e., both forms of data are present. Semi-structured data can be inherited such as location, time, email address, or device ID stamp.

The different types of big data are depicted in Figure 2 [5].

The process of examining big data is often referred to big data analytics. It is an emerging field since massive computing capabilities have been made available by e-infrastructures [6]. Big data analytics is the application of advanced analytic techniques to large, heterogeneous data sets that comprise structured, semi-structured, and unstructured data from many sources with sizes ranging from terabytes to zettabytes.

Analytics include statistical models and other methods that are aimed at creating empirical predictions. Data-driven organizations use analytics to guide decisions at all levels. Several techniques have been proposed for analyzing big data. These include the HACE theorem, cloud computing, Hadoop, and MapReduce [7].

CHARACTERISTICS OF BIG DATA

Big data is growing rapidly and expanding in all science and engineering, including physical, biological, and medical services. Different companies use different means to maintain their big data. As shown in Figure 3 [8], big data is characterized by 42 Vs. The first five Vs are volume, velocity, variety, veracity, and value.

- *Volume*: This refers to the size of the data being generated both inside and outside organizations and is increasing annually. Some regard big data as data over one petabyte in volume.
- *Velocity*: This depicts the unprecedented speed at which data are generated by Internet users, mobile users, social media, etc. Data are generated and processed in a fast way to extract useful, relevant information. Big data could be analyzed in real time, and it has movement and velocity.
- *Variety*: This refers to the data types since big data may originate from heterogeneous sources and is in different formats (e.g., videos, images, audio, text, logs). BD comprises of structured, semi-structured or unstructured data.
- *Veracity*: By this, we mean the truthfulness of data, i.e. weather the data comes from a reputable, trustworthy, authentic, and accountable source. It suggests the inconsistency in the quality of different sources of big data. The data may not be 100% correct.
- *Value*: This is the most important aspect of the big data. It is the desired outcome of big data processing. It refers to the process of discovering hidden values from large datasets. It denotes the value derived from the analysis of the existing data. If one cannot extract some business value from the data, there is no use managing and storing it.

On this basis, small data can be regarded as having low volume, low velocity, low variety, low veracity, and low value. Additional five Vs has been added [9]:

- *Validity:* This refers to the accuracy and correctness of data. It also indicates how up to date it is.
- *Viability:* This identifies the relevancy of data for each use case. Relevancy of data is required to maintain the desired and accurate outcome through analytical and predictive measures.
- *Volatility:* Since data are generated and change at a rapid rate, volatility determines how quickly data change.
- *Vulnerability:* The vulnerability of data is essential because privacy and security are of utmost importance for personal data.
- *Visualization:* Data needs to be presented unambiguously and attractively to the user. Proper visualization of large and complex clinical reports helps in finding valuable insights.

Instead of the 10V's above, some suggest the following 5V's: Venue, Variability, Vocabulary, Vagueness, and Validity) [9].

Industries that benefit from big data include the healthcare, financial, airline, travel, restaurants, automobile, sports, agriculture, and hospitality industries. Big data technologies are playing an essential role in farming: machines are equipped with sensors that measure data in their environment. Structured and unstructured data are generated in various types [10-13].

BIG DATA IN FINANCE

Big data is the ability to retain, process, and understand data like never before. It is when you have challenges that cannot be handled by traditional database systems. Big data is one of the most recent business and technical issues in the age of technology. Big data solutions are increasingly being used within the financial services industry. Big data in finance encompasses the profound impact and influence of data within the realms of finance, financial products, and financial services. It is the large amount of of structured and unstructured data that companies and financial institutions can use for their business: analyzing future trends, getting to know customers better, saving costs, etc. This data can come from various sources, such as credit card purchases, loan applications, social media interactions, and even mobile app usage. Big data in financial services empowers companies to be more agile, customer-focused, and efficient in a competitive marketplace. Harnessing big data to formulate best practices and drive financial decisions is key in achieving multiple missions [14]. Big data in finance is illustrated in Figure 4 [15].

Organizations use big data tools to store vast amounts of big data, so it is available for data analysis. Financial companies are increasingly using big data because of its many-core strengths. Some good ways to use big data include real-time insights, fraud detection, risk analysis, accelerating processes, decreasing instances of human errors, increased customer satisfaction, and analyzing company performance. The financial services sector has also started using big data to enhance risk management, detect fraud and track consumer behavior in order to keep up with compliance standards and increase customer satisfaction and revenues.

BIG DATA FINANCE EXAMPLES

Big data has been extensively utilized in finance for a significant period. There are numerous successful big data use cases to explore. The following real-life examples demonstrate the power of big data in financial analysis [16-18]:

- *Capital One:* This leading financial institution leverages Big data analytics to enhance risk management and improve customer experience. By analyzing vast amounts of customer data, Capital One can personalize credit card recommendations, offer customized rewards, and detect potential fraud attempts proactively.
- *Goldman Sachs:* This US company has been at the forefront of leveraging big data in finance to find better investment opportunities, gain a competitive edge, and provide better client services. It provides investment banking and financial services and uses big data to detect investment opportunities. To identify the best possibilities, the institution developed data-driven investment algorithms that assess thousands of businesses worldwide.
- *JP Morgan and Chase*: JPMorgan, which offers various financial services worldwide, uses analytics tools to integrate transaction data with information from other sources to gain deeper insights and accurately assess clients' creditworthiness. The company uses big data analytics to gain insights into market trends and make informed investment decisions. It utilizes predictive analytics to help its customers manage their working capital and cash forecasting needs. It also uses big data technologies to detect patterns in client behavior, helping identify potential revenue opportunities and market risks.

- *Wells Fargo and Company:* This US-based financial services company offers retail, wholesale banking, and wealth management services to individuals, businesses, and institutions. It turned to big data to improve business operations and customer service. It has enhanced customer experience and boosted revenue creation by improving risk management, customization, and segmentation. The bank has embraced big data analytics to optimize business operations, make data-driven decisions, and provide better client services.
- *American Express:* American Express is an American financial services company that offers credit, charge cards, and insurance services to individuals and businesses. The firm operates in more than 110 countries across the globe. The company utilizes big data in finance to enhance its fraud detection and prevention capabilities. By processing big data, it comprehensively views the cardholder's spending behavior.
- *Morgan Stanley:* Morgan Stanley, an American multinational investment and wealth management bank, utilizes big data technology to optimize its portfolio analysis, improve its financial operations, and offer better services to its clients. The banking stalwart collects massive amounts of data from various sources, including customer data, market data, economic data, news articles, social media posts, and others. Utilizing big data, they extract insights, trends, and hidden patterns to help financial advisors and clients make the right investment decisions to achieve their financial goals.

APPLICATIONS OF BIG DATA IN FINANCE

Big data applications help with gaining insights, measuring processes, managing costs, and elevating customer service. Big data and its applications work as indicators of organizations' ability to innovate to respond to market opportunities. Such applications include financial markets, banking risk and lending, Internet finance, financial management, financial growth, financial analysis, predictive analysis, data mining and fraud detection, and risk management. Figure 5 shows various use cases of big data in finance [18]. From risk management to regulatory compliance, the applications of big data analytics in financial services are numerous. Below are some of the common applications [18-21]:

- *Banking Industry:* The banking industry has significantly transformed from traditional brick-and-mortar establishments to modern data-driven financial institutions. This shift has been propelled by the advent of big data technologies that enable banks to analyze vast amounts of data for better decision-making. With the help of big data analytics, banks will find it easier to expand into new markets. For example, the Oversea-Chinese Banking Corporation (OCBC) analyzed huge amounts of historical customer data to determine individual customer preferences to design an event-based marketing strategy. Big data becomes increasingly crucial in any area of the banking industry. Figure 6 shows big data in banking [22].
- *Open Banking*. The concept of open banking, which allows third-party developers to create applications and services around a financial institution, is gaining traction. Big data will be at the core of this ecosystem, enabling more seamless and integrated services for customers.
- *Personalized Banking:* In a competitive market, providing a high-quality user experience is critical. There is a need to know who your clients are and, in some cases, to anticipate their wants. As a result, financial institutions are shifting from a business-centric to a customer-centric business strategy. Offering personalized banking is critical for financial institutions as it improves customer satisfaction and loyalty by tailoring financial services to individual needs and preferences. This allows banks to offer tailored lending solutions, insurance policies, and investment options that align with their customers' requirements and risk tolerance.
- *Fintech:* The word "fintech," stands for "financial technology," and refers to the application of various forms of technology to enhance and automate financial services. This can cover a wide variety of applications, ranging from investment management and insurance to mobile banking and digital payments. Big data's application in financial technology (fintech) has increased dramatically over the past several years, and it is anticipated to keep growing in significance. Big data is essential to fintech because it allows businesses to instantly evaluate vast amounts of financial data. As a result, they may spot patterns and trends that help them make smarter judgments, like figuring out which clients are most likely to default on loans or spotting fraud. Fintech businesses can spot possible hazards and take action to reduce them by analyzing vast amounts of data on market trends and client behavior. The use of big data in financial technology is shown in Figure 7 [23].
- *Accounting:* Big data in finance describes the enormous volume of data (structured,

unstructured, and semi-structured data) that financial institutions produce daily. Businesses use this data for accounting, finance, and auditing needs. As a result, businesses have increased efficiency and performance to get the best possible results in their operational activities by utilizing data in the audit and accounting departments.

- *Fraud Detection:* One of the most pressing issues in banking is fraud detection and prevention. Big data can be used to detect and prevent fraudulent activities by analyzing transaction patterns, identifying unusual behavior, and flagging potential risks. Big data analytics can monitor customer spending patterns and identify unusual behavior, thereby preventing unauthorized transactions. Big data and statistical computing empower banks to detect potential fraud before it even occurs. Specialized algorithms track and analyze spending and behavioral patterns, allowing banks to identify individuals who may be at risk of committing fraud. When credit card information that is both secure and valuable is stolen, banks can now immediately freeze the card and the transaction, as well as warn the consumer of the security danger. TD Bank has implemented up-to-date security standards to protect its systems and users' information against unauthorized access. By analyzing transactions and behavioral data, the system can flag potential fraud immediately, allowing TD to take immediate action to prevent financial losses.
- *Predictive Analysis:* Another massive benefit that big data tools have to offer is predictive analysis. Techniques like predictive analytics, machine learning, and artificial intelligence are used to forecast market trends, detect fraud, and personalize customer services. One of the key advantages of big data for banking is the ability to predict future trends before they occur. Using a non-biased equation to spot trends in numbers is a fool-proof way to estimate future earnings and losses. Big data analytics presents an exciting opportunity to improve predictive modeling to better estimate the rates of return and outcomes on investments. Businesses today leverage big data in finance for predictive analysis since it uses historical and real-time data to forecast future trends, risks, and opportunities. This predictive analysis helps lenders decide when to approve or deny their loan applications. Moreover, financial analysts can use big data to predict market trends and make investment decisions. Predictive risk models can anticipate potential financial crises or market downturns.
- *Customer Segmentation:* Big data in financial services can be used to identify different types of customers based on their spending habits and other demographic information. Segmenting customers based on their behavior and preferences allows financial institutions to proactively address the needs of different customer groups, helping them retain customers and reducing churn rate. Big data analytics is pivotal in segmenting customers based on their financial behavior and preferences. Big data can help businesses distinguish customers in different groups.
- *Asset Management:* Big data analytics offers a wealth of benefits to financial institutions in asset and wealth management. It enhances decision-making by providing insights into market trends and customer behavior while bolstering risk management through predictive analysis. The ability to analyze individual client data enables the provision of personalized services and investment advice.
- *Risk Management:* Big data improves risk management capabilities by providing organizations with the tools they need to identify, assess, and mitigate the risks. Big data techniques help to measure credit banking risk in home equity loans. Financial organizations use big data to mitigate operational risk and combat fraud while achieving regulatory and compliance objectives. With access to large amounts of historical market data, banks and other financial institutions can better assess risk associated with investments or loans by using predictive analytics models. This allows them to make more informed decisions about how many resources they should allocate toward certain assets or businesses.
- *Financial Inclusion:* Financial inclusion is a complex notion that encompasses the objective of guaranteeing universal access to a diverse array of inexpensive and suitable financial services and products offered by established financial institutions, for both individuals and enterprises. Financial inclusion encompasses a diverse array of initiatives, such as the provision of fundamental banking services including savings accounts and checking accounts, as exemplified by basic banking services. In the rapidly evolving landscape of financial technology (fintech), big data stands as a cornerstone, driving significant transformations. Big data has the potential to

bring about financial inclusion by helping banks understand the needs of underserved communities. Tailored financial products can be developed to cater to these identified requirements, thereby promoting economic equality. Big data catalyzes the development of novel financial products and services, enhances risk management, and boosts operational efficiency, thereby fostering financial inclusion. Big data's capability to offer insightful customer behavior analytics is highlighted as a key driver for creating inclusive financial services.

BENEFITS

The investment management company uses big data in finance to analyze vast amounts of financial data, economic indicators, and market trends. By leveraging large datasets, companies can gain valuable insights into customer behavior and preferences, optimize their operations, reduce costs, and improve customer experience. Big data is completely revolutionizing how the stock markets worldwide are functioning and how investors are making their investment decisions. Other benefits include the following [19]:

- *Automation:* Automating tasks increases productivity and makes the work of financial services analysts, managers, and associates easier. You may manage every financial process with greater speed, performance, and value with the help of automation. Big data technologies can automate up to 30% of all work within banks, leading to significant cost savings and reduced risk of human error. Big data boosts operational efficiency by automating data analysis processes, leading to cost reductions and improved service delivery. As a result of advanced automation, banks can experience significant cost savings and reduce the risk of failure by eliminating the human factor from some critical processes. JP Morgan Chase & Co. is one of the automation pioneers in the banking services industry. It has significantly decreased the human error associated with loan-servicing.
- *Cost Reduction:* Big data can automate several manual tasks, such as compliance checks, fraud detection, and risk management. Businesses can also use big data analytics to improve efficiency in various areas, such as customer service, risk management, and marketing. Big data can also help businesses reduce costs.
- *Customer Profiling:* Big data plays a crucial role in customer profiling within banking institutions. Banks can offer individualized plans and financial solutions by analyzing a customer's banking history and personal and transactional information, and monitoring customer spending patterns over time. Big data enables financial institutions to personalize customer experiences by analyzing customer data, such as their financial history, preferences, and behavior. This enhances the customer experience and enables banks to differentiate their services, increasing customer retention.
- *Enhanced Customer Experience*: Customer satisfaction is at the forefront of everyone's minds in this current financial climate. Big data in banking and financial services is pivotal to improving the level of client satisfaction. Customer preferences and needs are changing fast in this age of digital transformation. Big data is crucial in improving user experience by providing insights that enable businesses to understand their customers better, engage with them, and meet their needs. Big data technologies enable banks to understand their customers on a granular level. Banks can offer personalized banking solutions by analyzing various customer data points like investment habits, shopping behaviors, and financial backgrounds.
- *Scalability:* Scalability is a feature of data integration solutions that allows them to grow as business needs change. Big data solutions must be able to scale up or down depending on the needs of the financial services organization. Solutions should be able to handle large amounts of data and complex calculations quickly and efficiently, while also being flexible enough to accommodate changing business requirements.
- *Social Responsibility*: Big data will play a major role in helping banks become more socially responsible. Analytics can help financial institutions understand their investments' environmental and social impact, leading to more sustainable business practices.
- *Improved Decision-making:* The success of every business in the financial space hinges on the ability to make decisions that increase the company's business while shielding it from risk. Big data in finance can significantly improve decision-making by providing valuable insights into market trends and customer behavior, allowing them to predict future outcomes. Big data analytics in financial services provides access to vast amounts of information that can be used to make more informed decisions. This helps businesses improve risk management processes as well as product development strategies.

- *Competitive Advantage:* The implementation of big data analytics is key to maintaining a competitive edge in the financial sphere. Big data is a key driver for gaining a competitive edge in the financial industry, enabling institutions to better understand markets, minimize risks, and deliver value to their customers, improving client satisfaction and long-term loyalty. Taking advantage of the vast amounts of data available from different sources, financial companies can keep their competitive edge, make stronger, data-driven decisions, and increase the efficiency of business operations. Big data analytics allows financial institutions to make data-driven decisions, giving them a competitive edge. Companies can gain insights into market trends, customer behavior, and risk factors by analyzing vast amounts of data.
- *Operational Efficiency:* Big data in financial services enhances operational efficiency and reduces costs by process automation. Big data in financial services can automate such processes as loan approvals, customer onboarding, and compliance checks. Big data analytics tools can identify unprofitable branches and initiatives, helping financial enterprises boost efficiency. In addition, big data analytics solutions can automate processes such as fraud detection, credit scoring, customer segmentation, and feedback analysis, speeding up operations and saving resources. Automation reduces human error, speeds up workflows, and cuts operational costs. This also improves customer satisfaction as customers are offered a better, smoother experience.
- *Regulatory Compliance:* Regulatory compliance is a critical aspect of businesses, especially in finance. Fraud undoubtedly costs the industry a lot of losses, but failure to comply with regulations creates a potential for even greater liabilities in the form of hefty fines from governing authorities. Big data analytics and business intelligence (BI) tools significantly streamline the process of regulatory compliance. It can help financial institutions comply with complex regulations by monitoring transactions, identifying potential risks, and reporting data to regulatory agencies. This includes complying with anti-money laundering regulations, KYC (Know Your Customer) requirements, and other regulatory obligations.
- *Cybersecurity:* AI and big data technologies are instrumental in identifying fraud and preventing internal risks. Banks are leveraging big data analytics and AI tools to bolster their cybersecurity measures in the face of increasing cyber threats. These tools can track customer behavior and internal activities, helping to identify potential security risks.

Figure 8 shows some of these benefits [18].

CHALLENGES

While big data offers many benefits to the banking sector, it also presents its own challenges and concerns. Addressing ethical concerns related to data bias, algorithmic fairness, and data misuse is important. Other challenges include the following [19]:

- *Privacy Concerns:* One of the major challenges with big data is privacy concerns. In many places, banks are the second-biggest hoarders of personal information after the government. Financial services companies are required to protect customer information from unauthorized access or misuse. Big data in fintech requires large amounts of personal information which can be vulnerable if not properly secured.
- *Ethical Concerns:* Using big data analytics to profile banks' target customers raises ethical questions about discrimination and fairness. Banks need to be cautious to ensure that their use of data does not result in unfair or biased outcomes.
- *Data Security*: The financial industry is a prime target for cyberattacks. The more extensive the data, the higher the risk of cybersecurity threats. Protecting sensitive customer information remains a significant concern, especially when banks collect and apply users' data. The financial service industry must invest heavily in robust cybersecurity measures to mitigate these risks.
- *Data Quality:* Ensuring data quality and integrity is crucial for accurate financial analysis. Poor data quality can lead to incorrect analysis, which in turn can result in flawed decision-making. With the sheer volume and variety of data, financial institutions may face challenges related to data completeness, accuracy, and consistency. Ensuring the data's quality, management, and integrity is a constant challenge. Data cleansing techniques, such as data validation and data normalization, are essential to remove duplicates, errors, and inconsistencies.
- *Data Silos:* The inability to connect data across department and organizational silos is now considered a major business intelligence challenge, leading to complicated analytics and

standing in the way of big data initiatives. Financial institutions have large volumes of data scattered across various systems. This creates data silos, which can prevent comprehensive analysis. Addressing this issue requires a multilayered approach that includes creating centralized data repositories, standardizing data formats, and establishing data governance frameworks.

- *Complexity:* The data's complexity is a significant challenge. Data is collected through various activities with distinct goals, which is the cause of these errors and difficulties. Specifying how filters should be applied is vital so that no crucial information is lost. There are billions of pieces of data being produced from diverse sources; missing data is a major concern, and data quality and dependability are also important issues.
- *Anomaly Detection:* Big data analytics enables financial institutions to identify anomalies and unusual patterns in transaction data. By analyzing historical transaction records, banks can build models that highlight deviations from normal behavior. These models can flag suspicious activities, such as unusually large transactions, multiple transactions from different locations, or transactions outside the customer's usual spending patterns.
- *Regulatory Compliance:* Financial institutions must comply with data privacy laws and regulations, and managing big data while complying with these regulations can be challenging. Banks must adhere to various data storage, usage, and sharing regulations. Compliance becomes increasingly complex with the growing volume of data being processed, and non-compliance can result in severe penalties.
- *High Implementation Costs:* Implementing big data technologies requires substantial hardware, software, and skilled personnel investment. Smaller financial institutions may find these costs prohibitive, thereby creating a competitive disadvantage.
- *Skill Gap:* Another challenge associated with big data is the lack of skilled personnel who understand how to effectively utilize it within the financial services industry. Finding and retaining skilled data scientists and analysts is a significant challenge. The specialized skills required for big data analytics are in high demand, but they also require more supply. The demand for skilled professionals can slow the implementation process and affect the quality of insights derived from the existing data.
- *Customer Trust:* Customers are increasingly concerned about how their data is used. Transparency in data usage policies is essential to maintain customer trust, but achieving this transparency can be very challenging.

CONCLUSION

Big data is no longer a nice-to-have but a must-have for financial institutions aiming to stay competitive in today's data-driven world. It has completely transformed the fintech industry. Banks and other financial institutions are using big data to improve their operational performance, make better decisions, and provide more personalized services to their customers. Big data is playing an increasingly important role in the financial services industry. It is completely revolutionizing how stock markets across the world are functioning and how investors are making their investment decisions.

The maximum potential of big data in banking and finance is yet to be harnessed. The future of big data in the finance sector appears promising, with numerous opportunities for innovation and improvement. It will be shaped by the ability of financial institutions to extract and deliver more customer value from data. As big data technology develops, financial institutions can build innovative products and services that will cater to the evolving needs of consumers and investors. More information about big data in the financial services can be found in the books in [24-27] and the following related journals:

- Journal of Big Data
- International Journal of Logistics Research and Applications.

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Figure 1 Different components of big data [3].

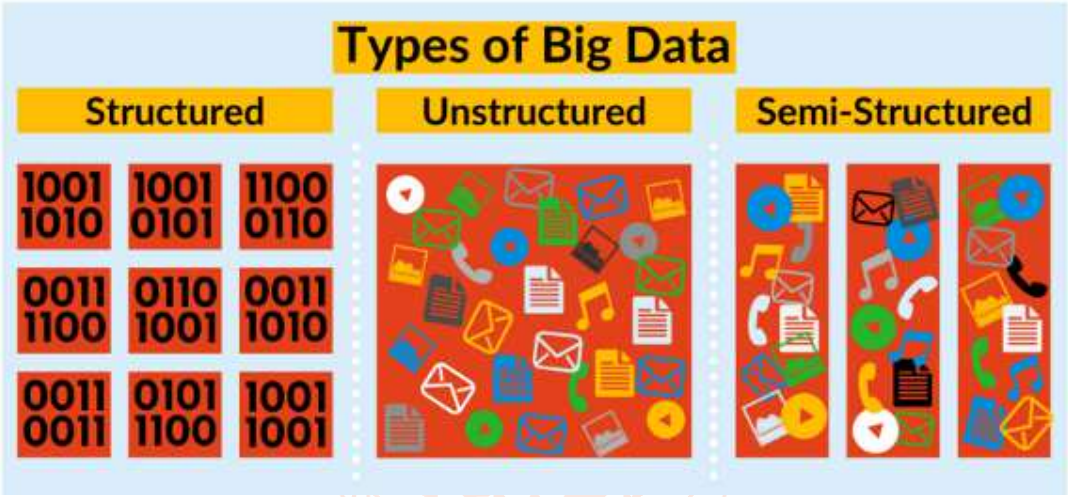

Figure 2 Types of big data [5].

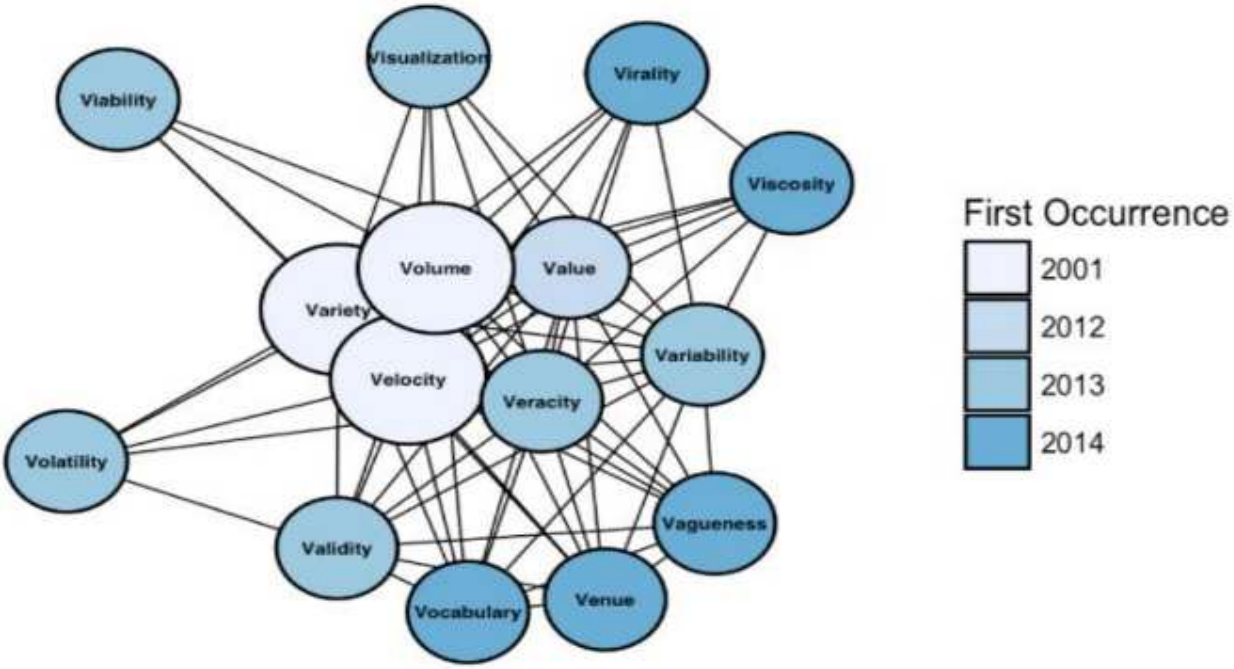

Figure 3 The 42 V's of big data [8].

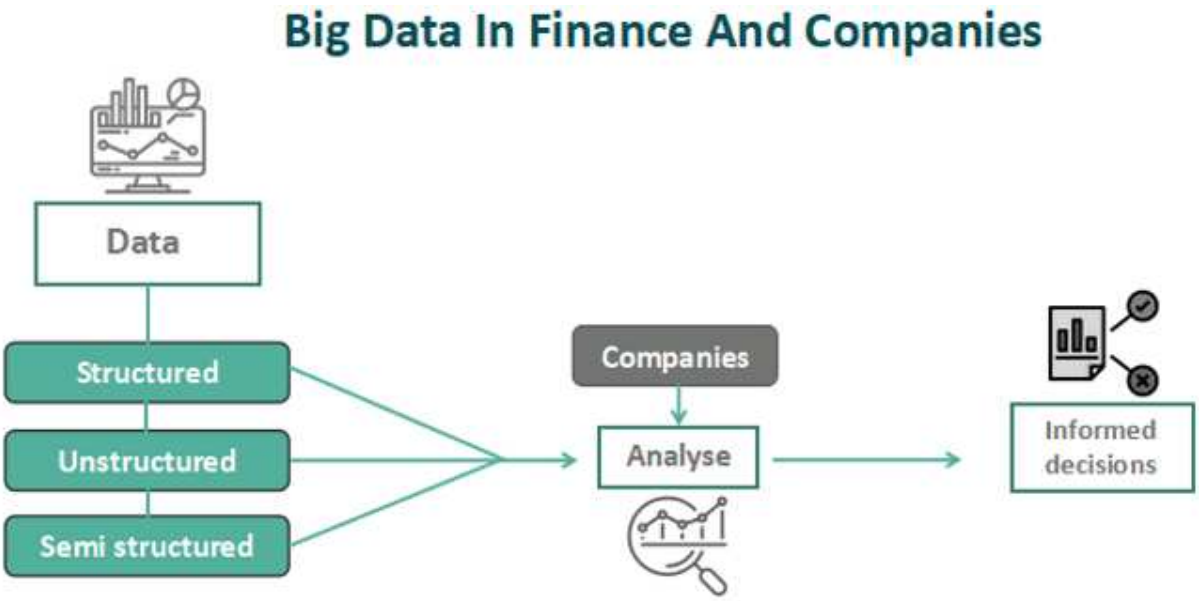

Figure 4 Big data in finance [15].

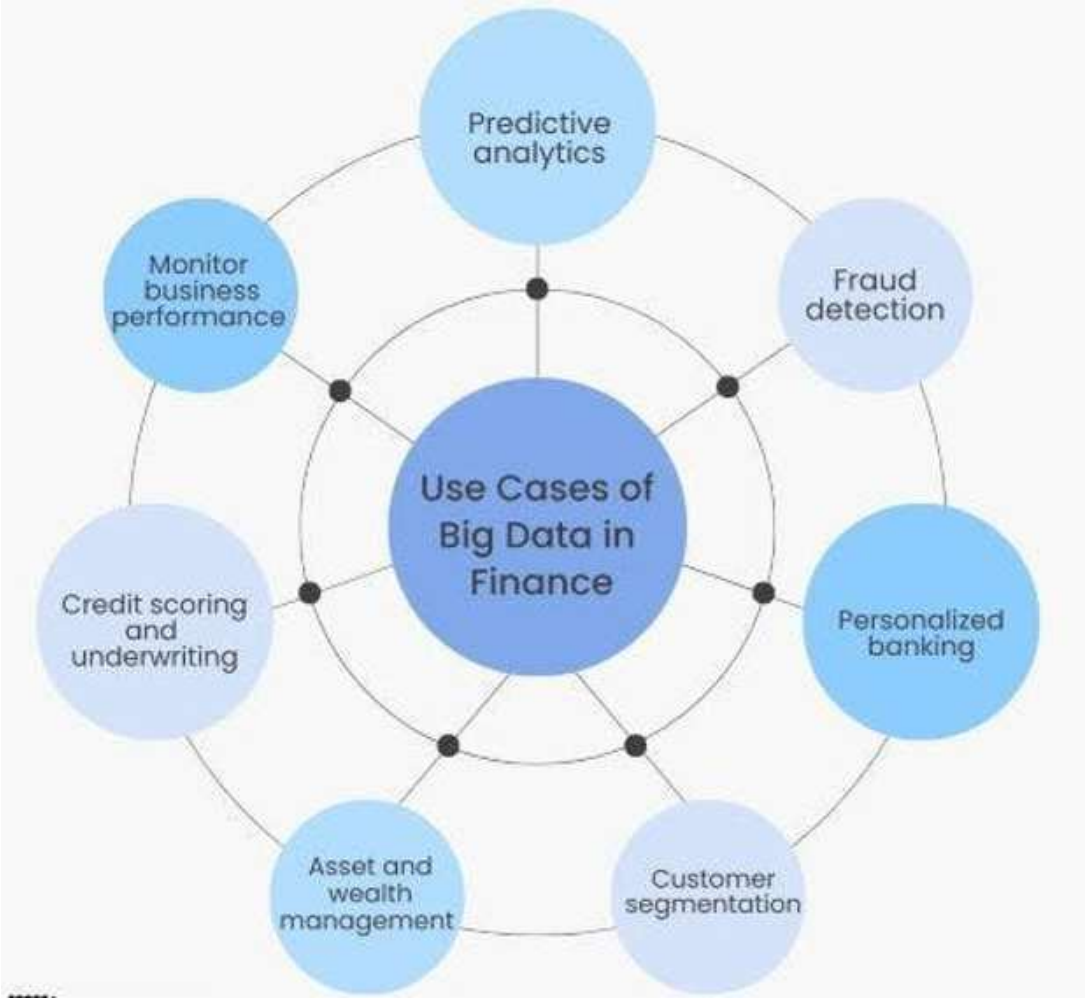

Figure 5 Use cases of big data in finance [18].

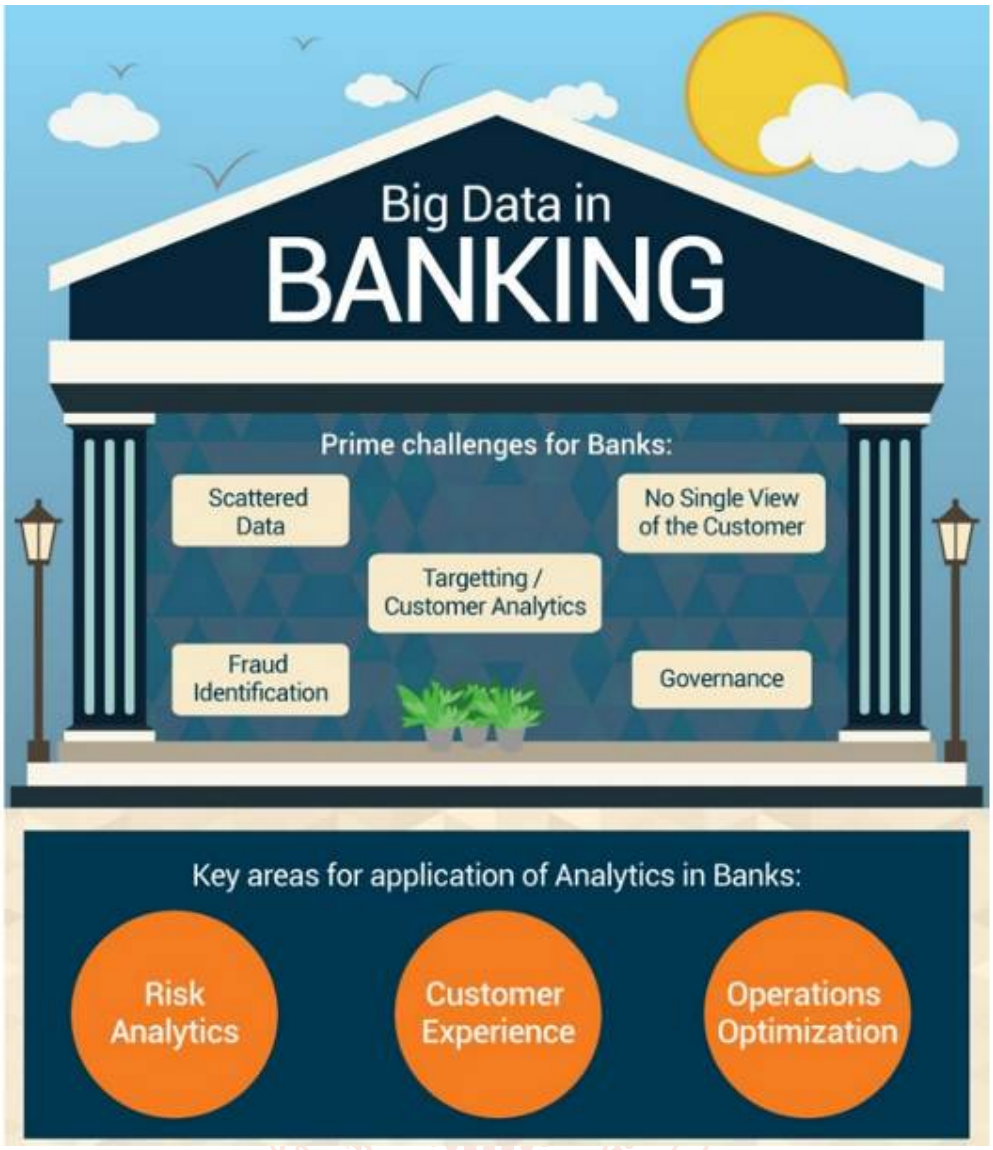

Figure 6 Big data in banking [22].

Figure 7 The use of big data in financial technology [23].

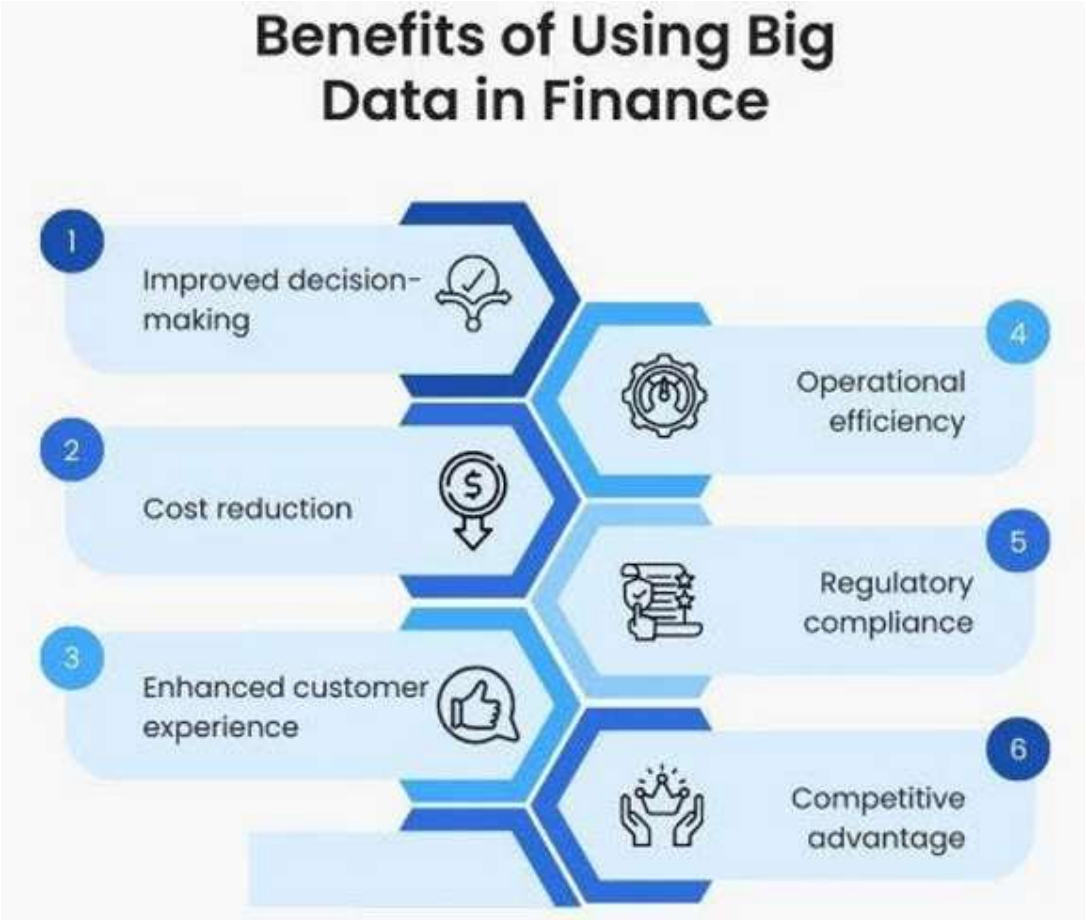

Figure 8 Some benefits of big data in finance [18].