# Big Data Security and Privacy Concerns: A Review

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**Abstract**

The past few decades have recorded increases in the development of new technologies. These technologies, such as the smart phone, computers, and social network sensors, have resulted in the production of a large amount unstructured data from different formats ranging from Tera Bytes (TB) to Peta Bytes (PB). This huge and differently formatted data is known as big data. Big data has a great potential for both the public and private sector. The utilisation of big data can have a positive impact. Different tools and techniques such as analytics and data mining are being used to make the data useful. However, big data is beset by security and privacy issues. Researcher from different domain are trying to overcome the issues in the big data, this paper will focus on the applications and major security, and privacy issues of big data.

**Keywords**

Big data • Data analytics • Privacy • Security

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## 1 Introduction

The past few decades have recorded increases in the development of new technologies. These technologies, such as the smart phone, computers, and social network sensors, have resulted in the production of a large amount unstructured data from different formats ranging from Tera Bytes (TB) to Peta Bytes (PB). This huge and differently formatted data is known as big data. Big data has a great potential for both the public and private sector. The utilisation of big data can have a positive impact, for example, on health care. A hospital will be able to store and analyse patient data to prevent the outbreak of diseases. Business can also make use of this data. A company can analyse its customer sales record to determine customer choices and thereby make informed decisions about the effective sourcing and distribution of goods and services in a timely manner, and thus increase profits and make customers happy.

Big data is already used by Google as a distributed storage system called Bigtable that has been designed, implemented, and deployed to manage structured data. This system has the reliability to handle thousands of machines and PB's of data, and has achieved several goals including wide applicability, scalability, high performance, and high availability. The system is also used in Google products [1].

Government can use big data for transparency in public affairs for citizen engagement, to prevent fraud and crime, to improve national security, and to comfort the common citizen. The government sector deals in general issues (like data from multiple sources with different formats or costs), special issues (e.g., data from different sources of the government), and sharing of the data with sources of big data [2] (Fig. 1).

Some significant and insightful studies have been done to show the importance of big data, but there are still some questions that need to be asked about what big data means, how and which data to access [3], and what security and privacy challenges big data faces. This article will contain



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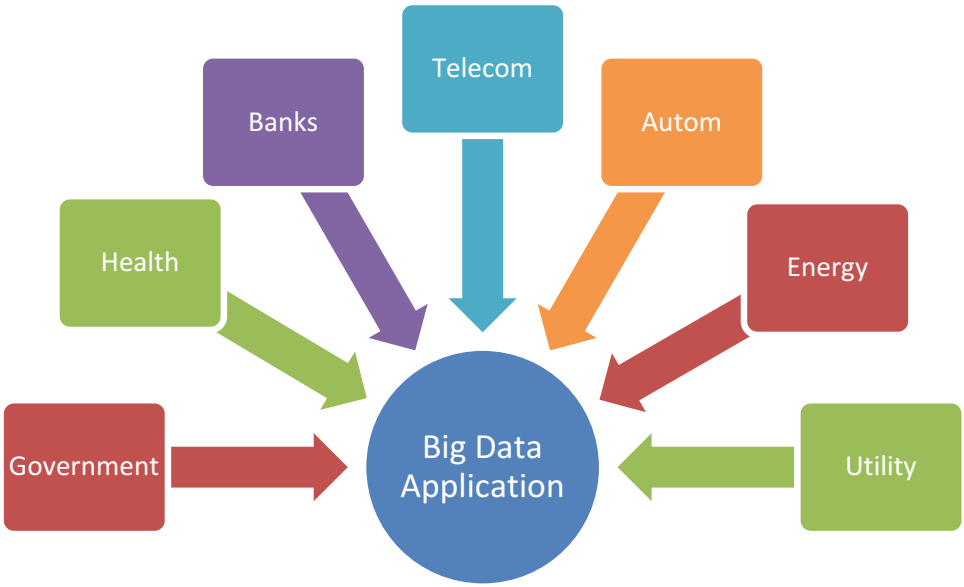


**Fig. 1** Big data applications

five sections. Section 2 will be about the definition, section 03 Applications of Big data and characteristics of big data, and Sect. 3 will be about security and privacy concerns for big data, along with possible solutions.

### 1.1 Big Data Definition

Although there is no proper definition for the term, it is safe to say that 'Big data' can be used for large data sets (unstructured, different formats) that cannot be managed by traditional database management systems. The processes for storing, retrieving and managing the different types of data within a suitable time frame can be difficult for traditional common software. Daily data's size constantly increases by a few dozen TBs to PBs in a single data set [4]. In today's world, people are generating data through technology faster than before [5]. This huge amount of data, which is mostly generated by social media, cellular phones, and other digital communication devices can be the true form of big data [6]. Due to its usage and application in decision making, big data has become more attractive and accessible to the public sector, the private sector, and the field of academia [6].

Big data and analytics can have a positive impact on business and industry. Companies can invest in big data, analytics, and other technology to track customer needs and preferences, and to provide an easy access to goods and services by various accommodating small markets. Big data can also help find problems on a societal level by using new technology For example, big data can be used to identify new trends in health care, prevent diseases, and much more. If the data is managed well, it can also help find new sources of economic growth [7].

### 1.2 Characteristics of Big Data

Big data has been characterised by the 3Vs: Volume, Velocity, and Variety, Simply put, volume refers to its huge size, velocity to the speed of its creation, and variety to its differentiated formats and sources. A later study suggests that 3Vs are insufficient to describe big data, so more components have been added to include Volume, Velocity, Variety, Veracity, and Complexity [8] (Table 1).

### 1.3 Big Data Timeline

The concept of a 'Database Machine' emerged in the 1970s. The aim was to store and analyse data with the help of technology, but due to huge increases in the demand for data processing, the single machine was insufficient. Therefore, in order to meet the requirement of 'share nothing', a parallel system was proposed in 1980. The architecture of 'share nothing' was based on the cluster that every machine has its own processor, storage, and disk [14]. The availability of the World Wide Web in 1991 opened the door to the public, which later on in 1998 lead to the concept of IOT [15].

It is predicted that the current volume of data will grow from 130 Exabyte to 40,000 Exabyte between 2005 and 2020, which means that the growth of the data will be double

**Table 1** Volume, velocity, variety, veracity, and complexity

| Factor | Identification | References |
|---|---|---|
| Volume | Volume is a huge amount of data that is created from different sources (transactions, unstructured streaming from text, images, audio, VoIP, video, TV, and other media, sensor, and machine-to-data) | [9] |
| Velocity | Velocity refers to the rate of change of data or how often the data is created | [10] |
| Variety | Data variety is the measure of the variety of data (text, images, video, and audio); one of the best challenges to the effective use of big data is data variety for analytics, because of incompatible formats, lack of structure, and inconsistencies | [11] |
| Complexity | Complexity denotes the data that comes from multiple sources that needs to be linked, matched, cleaned, and transformed | [12] |
| Veracity | Veracity is the reliability of data linked with different types of data just like correctness, truthfulness, and accuracy | [13] |

after every two years. This is why this huge amount of data—big data—is attracting researchers to find solutions for various government and industrial problems [16].

## 2 Big Data Applications

The role of big data can be helpful for many public and private sectors; some of the examples are listed below.

### 2.1 Big Data in Healthcare

According to history, most of the data [17], that has been recorded is by the healthcare sector for record keeping, compliance, and retention of patient care records; most of the data recorded is in hard form [18]. Use of a proper system to collect and analyse the data can help the healthcare industry to improve the quality of life. The future of big data analytics predicts an increase in epidemics, cures, and diseases [19]. Big data can also assist the government sector by indicating areas where the government can take action and save thousands of lives. Big data in healthcare can be divided into different sub-categories like bioinformatics, neuro-informatics, clinical informatics, and public health informatics. Bioinformatics mainly focus on molecular data; analytic tools can be used to know how the body works by using molecular data. The main focus of neuro-informatics is to know how the brain works and how the data gather from brain images and medical conditions can even be associated. Research on clinical information helps GP's to get better and more accurate decisions about their patients by analysing their data. Public health informatics deal with public data to analyse and get accurate medical information [20].

### 2.2 Big Data for Government

Big data can play a vital role in the government sector, because this sector is always trying to improve quality of life. The government only needs to have an advanced system in order to collect and analyse data that can help them identify areas they need to focus on. However, the government needs to have a look at the data, and information policies like privacy, data reuse, data accuracy, data access, archiving, and preservation as play with data can have privacy and security issues [21].

### 2.3 Intelligent Transportation

The development in communication [22] and robotic technology had a good impact on the life of common people. Advancements in these technologies have given rise to an opportunity for the autonomous vehicle to be created. The aim to introduce autonomous vehicles is to reduce costs and increase transportation accessibility [23]. The sensor is another important technology. Advancements in sensor technology open the door for innovation. Transportation includes sensor technology with the Global Position Satellite (GPS) system and on-board cameras. GPS systems help vehicles locate the required route, and sensor technology enabled with traffic control systems help control the vehicle [24]. One example of intelligent transportation and the autonomous vehicle is the Google car; this car is enabled with a camera, 3-D radar/range finder, and an artificial intelligence system that is use for calculation. A combination of all these technologies and others has enabled the launch of the self-driven car [25].

## 3 Big Data Security and Privacy

Security and privacy are the big hurdles for users who have to outsource their data. For sensitive and personal data, specific laws need to be established. For example, data protection and privacy concerns have been regulated in different countries [26]. Databases related to the government or people need a high level of security polices and mechanisms to secure them against illegal and malicious use. That big data technology such as Hadoop and Cassandra are suffering from insufficient security is of serious concern [27] Moreover, technologies and mechanisms like firewalls and DMZ's for security and privacy cannot be applied or used for big data because of its vast border. Big data security objectives are the same as other data types (e.g., confidentiality, integrity, and availability [28].

Cloud Secure Alliance (CSA) has classified four main challenges for big data security: infrastructure security, data privacy, data management, and integrity and reactive security [29] (Fig. 2).

To provide security to the infrastructure, distribution computations and data stores must be secured. To secure data information distribution, privacy must be protected, and the sensitive data must be secured with cryptography and granular access control. Managing large volumes of data requires scalable and distributed solutions to secure data storage and to provide efficient audits and data sources. Data integrity must be checked for data coming from diverse sources and analytics for security can be performed to ensure the health of the infrastructure [30].

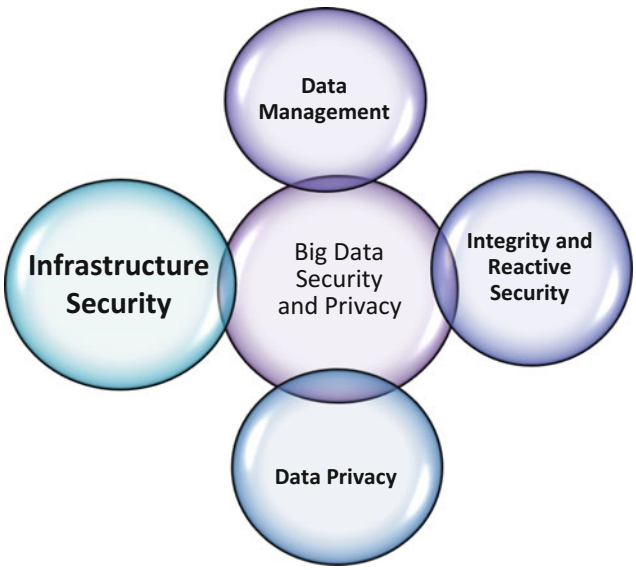


**Fig. 2** Big data privacy and security domain

### 3.1 Infrastructure Security

Modern science infrastructure is solving new large-scale problems; these solutions were not possible before, as they produce huge amounts of data capable of storing, distributing, and processing these data. This is referred to as scientific data e-infrastructure. The scientific data is more complex and interrelated with other objects. As things become new and technology-driven, big data science requires solutions to a number of components and challenges [31]. One of the basic challenges is processing of huge data. The collection of data is easier than the processing of it because the complete behaviour of data (structure, value, format, etc.) needs to be analysed and understood. For example, social media allows any format of data by the user, but the volume can be increased to a level that can be difficult to manage, because the amount of data that a single processor can process is still limited. In order to process this huge data, special algorithms need to be designed [32].

### 3.2 Data Privacy

One of the sensitive problems that big data is facing is data privacy. Manipulation of data can cause a privacy issue, like information collected from the user and used for the business purposes of an organisation about which the user is unaware, or that user information is collected and combined with other data to get certain results [33]. A lot of personal and private information that can include health, medical, financial, bank, and much more can be accessed, which may be a violation of a personal legal right for privacy. Therefore, the field should make sure that all the privacy policies are properly placed [34]. Social media and health informatics are the biggest sources of data collection. One of the threats to personal security is the unregulated collection of data by different organisations, especially by social media companies. Developing an algorithm that can randomise the data among other data sets is a major research problem [35].

### 3.3 Data Management

Management of data is another one of the difficult issues that need to be addressed by big data. Although data is already managed by traditional ways in the business world, it will still be difficult if the data is distributed to different places that are owned and managed by different entities, and coming in at a large volume; hence, a big management solution is required [36]. Dealing with big data is a difficult task because of the huge amount of data with different formats (picture, audio, video, etc.); yet, this can be handled. The problem becomes worse if the data is stored in different

geographical locations. In this case, it becomes impossible to manage the data. Management of data plays a key role in large organisations. Various technologies like Hadoop, MapReduce, and Hive have been introduced to the market to manage data. Hadoop data is broken down into several parts that can be spread into a number of systems. In this process, data is repeated many times on different nodes to provide a security for any failure node [37].

### 3.4 Integrity and Reactive Security

It is difficult to check the trustworthiness of big data's differentiated sources, but the data from varied sources can be used by certain algorithms to produce accurate results. Authenticity and integrity of data must be considered [38]. Data integrity is a key element for collaborative analysis where analysts and decision makers use information within organisations. Mostly, data mining approaches are being applied to improve the efficiency of decision making. Integrity can also be affected by the quality and reliability of data. Basically, integrity is the prevention of illegal and unauthorised access to the data [39]. In the field of information security, data integrity's main concern is maintaining and assuring the accuracy and consistency of the data by preventing unauthorised access. For maintaining integrity, all the characteristics of data must be correct, including business rules, relations, definitions, and so on [40].

**Quality and Reliability of data**. Quality of data has a high importance for big data utilisation. Low quality of data is just a waste of resources and transmission. A lot of factors can be included to restrict the quality of data including generation, acquisition, and transmission. Quality of data is mainly important for accuracy, completeness, redundancy, and consistency. The problems related to quality need to be addressed; therefore, effective methods to detect the quality of data automatically and repair the data need to be examined [41]. Reliability of data—whether or not we can trust data—accuracy, consistency, and completeness are all essential [42].

## 4 Research Trend in Big Data

The author in the article [43], briefly overview the issues related to big data and email security. The analyses of the data showed in the article, describe the threat related to big data. According to author, different type of threat like malware can trap the data easily. The author proposes to have a framework with having guidelines for the prevention big data security.

The article [44], reviewed the primarily security issues related to energy big data analytics and for internet of thing based smart grid. According to author the smart grade can benefit from the IoT Technology, meanwhile the smart devices are integrated with so huge number, that now they are causing the main security for the internet based smart grid. The data need to be kept save form intrusion and privacy, if we want to be benefited from the smart grid and big data.

According to author [45], modernization in the technology also arise the volume of big dat. A much more focus need to be given to secure sensitive health care data from adversaries and malicious software. That will help to maintain integrity and privacy of sensitive information. The security issues therefore must be dealt and new security need to build in health care context. The availability and protection of data without having the privacy concern will determine the potential to adopt the health care data into the cloud environment.

The author in the article [46], proposed solution in order to overcome the issue associated with storage of big data through could compute. As the adoption of cloud computing services for storing big data is increasing with a rapid speed. According to author there are still many open security risks that need to be addressed in the cloud. The confidential data store at cloud could have a security risk on data file in one place.

## 5 Open Security and Privacy Challenges

Big data is facing numerous challenges; some of the research challenges identified by researchers of big data security and privacy are as follows:

- Scalable and compostable privacy preserving data mining and analytics [47].
- Risks in outsourcing and use of third-party tools [48].
- Organisational learning culture and competencies [49].
- Lack of infrastructure to insure the security of data (integrity, accountability, availability,) and become more vulnerable if data is from different sources [50].

## 6 Conclusion

Indeed, big data can be a gold mine for both the public and private sector, as it can be used for variety of purposes. Business can boost and government can improve health facilities by using this huge data. Yet, at the same time, big data also faces a lot of challenges including data management, infrastructure, and analytical issues, as well as security and privacy issues and data visualisation. Therefore, big data is the main focus of research for many researchers. This

paper discussed big data literature, security, and privacy concerns, and listed current big data privacy and security issues.

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