Big Data in Information Systems: A Review

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Authors' contributions

The sole author designed, analysed, interpreted and prepared the manuscript.

Review Article

ABSTRACT

The emergence of big data has brought about a significant transformation in the domain of Information Systems, presenting academics and companies with unparalleled prospects and complexities. This abstract examines the potential risks and benefits associated with conducting research in a dynamic and fast growing field. The field of Information Systems is characterized by the significant potential of big data research to bring about transformative effects on various sectors and societies. However, this promising development also gives rise to apprehensions surrounding issues of privacy, ethics, and data security. The potential benefits of big data research are many and varied. First and foremost, this technology offers the potential to extract practical and applicable knowledge from extensive and varied collections of data. This, in turn, facilitates decision-making based on data, fosters innovation, and enhances effectiveness across multiple industries. Furthermore, it enables the progression of cutting-edge technologies, such as machine learning and artificial intelligence, which possess the capacity to propel substantial improvements in the field of Information Systems. In conclusion, the utilization of big data research has the potential to augment our comprehension of intricate phenomena, facilitate predictive analytics, and stimulate the advancement of tailored services, consequently amplifying user experiences. Nevertheless, the potential risks associated with conducting big data research are equally substantial. The rapid expansion of data gathering and analysis has given rise to apprehensions regarding the protection of data privacy, security, and ownership. Academic researchers are confronted with the task of

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effectively addressing ethical quandaries pertaining to the acquisition and utilization of sensitive personal data. Furthermore, it is imperative to carefully contemplate the significant concern around algorithmic bias and discrimination in the context of data-driven decision-making. Furthermore, the considerable quantity and intricate nature of data provide obstacles in relation to the quality of data, the administration of data, and the ability to scale.

Keywords: Big data; information system; security; data security.

1. INTRODUCTION

Within the dynamic realm of Information Systems (IS), a notable subject that has garnered considerable interest from researchers, practitioners, and the industry is the concept of Big Data. The current epoch of Big Data is distinguished by an unparalleled upsurge in the acquisition, accumulation, retention, and examination of data, which has fundamentally transformed the operational processes, decision-making practices, and value creation strategies of enterprises. The aforementioned disruptive power has not only redefined the boundaries and potential within the domain of Information Systems but has also introduced a wide range of intricate issues that necessitate inventive solutions and a more profound comprehension. This introduction serves as a launchpad into the broad and dynamic arena of Big Data research in Information Systems, giving light on its relevance, historical evolution, and the various avenues of exploration it offers [1-4].

In the dynamic and ever-changing context of the Information Age, data has emerged as a crucial and indispensable element for the functioning and development of contemporary civilization. The exponential growth of digital gadgets, interconnected systems, and the continuous increase in data generation has resulted in a significant transformation in the prevailing paradigm. The aforementioned transformation is attributed to the emergence of Big Data, a significant phenomenon that is altering various aspects of our lives, occupations, and comprehension of the global landscape. The topic of Big Data study is characterized by its dynamic and interdisciplinary nature, and it has emerged as a crucial factor in effectively utilizing the vast amount of data available and understanding its significant societal, economic, and scientific consequences. The fundamental nature of Big Data is in its vast scale. The phenomenon under consideration is distinguished by huge quantities of data, produced at an unparalleled rate, and showcasi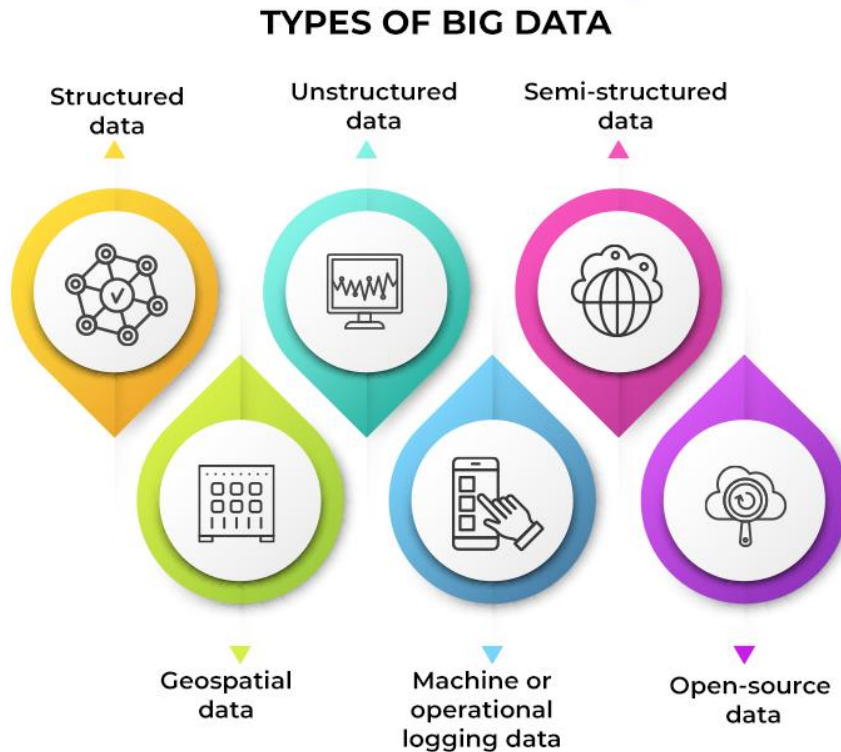ng remarkable diversity in terms of data formats, origins, and arrangements. Big Data surpasses conventional data processing capabilities, encompassing various sources such as the social media interactions of billions of individuals, the terabytes of sensor data generated by smart cities, and the genetic information contained within the human genome. Within this vast reservoir of information, profound thoughts and valuable knowledge lie concealed, eagerly awaiting revelation. Nonetheless, the task of deriving significant patterns, predictions, and insights from these vast datasets presents a significant challenge, which has contributed to the emergence of Big Data study [5-8].

The central focus of Big Data study revolves around the pursuit of enhancing methodologies, tools, and approaches to effectively acquire, retain, manipulate, scrutinize, and present data on an unparalleled magnitude. The research domain encompasses a wide range of academic disciplines, including as computer science, data science, statistics, mathematics, engineering, and social sciences [9,10]. The incorporation of advanced technologies such as cloud computing, machine learning, artificial intelligence, and distributed systems is employed to effectively tackle the complex obstacles presented by Big Data. The application of Big Data research spans across various sectors, encompassing healthcare, banking, climate science, and entertainment, among others. Big Data analytics in the healthcare sector possess the capacity to significantly transform patient care by facilitating predictive diagnosis and individualized treatment protocols. Within the field of finance, the examination of extensive datasets has the potential to augment risk management practices, facilitate the identification of fraudulent activities, and optimize investment methods. Likewise, within the field of climate research, the examination of extensive environmental information can yield unique perspectives on the phenomenon of climate change and its associated consequences [11,12].

In addition to its uses within certain sectors, research on Big Data has the potential to

facilitate innovation and reveal latent connections that can contribute to economic advancement, scientific exploration, and societal transformation. Governments, industries, and academic institutions are progressively allocating more resources towards the exploration of Big Data, acknowledging its capacity to influence forthcoming developments [13,14].

Numerous challenges are present within the domain of Big Data research, including issues related to data privacy and security, as well as ethical considerations pertaining to the utilization of data. The current discourse is around the ethical and legal ramifications associated with the collection, storage, and analysis of vast databases, as well as the concerns around data bias and discrimination [15,16].

TYPES OF BIG DATA

Structured data

Unstructured data

Semi-structured data

Geospatial data

Machine or operational logging data

Open-source data

Fig. 1. Big Data Types

Fig. 2. Big Data Benefits

Fig. 3. Big Data

1.1 Information Systems

In the contemporary globalized society, characterized by rapidity and interconnectivity, information systems assume a vital and irreplaceable function in the operations of various entities, including corporations, societies, and individuals. These systems serve as the fundamental infrastructure of contemporary society, enabling the acquisition, manipulation, retention, and distribution of data in manners that have revolutionized our lifestyles and professional endeavors. Information systems have emerged as a crucial element in various domains of human existence, encompassing business, government, healthcare, education, and entertainment. In order to comprehend the importance of information systems, it is imperative to thoroughly examine its diverse facets, functionalities, and influence on our global society [17,18].

1.2 The Essence of Information Systems

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domains of human existence, encompassing business, government, healthcare, education, and entertainment. In order to comprehend the importance of information systems, it is imperative to thoroughly examine its diverse facets, functionalities, and influence on our global society [19-22].

1.3 Key Functions of Information Systems

Data management is a critical aspect of information systems, since it plays a pivotal role in the efficient organization, storage, and retrieval of data. Databases, file systems, and data warehouses are among the several instruments employed in the realm of data management [23].

- **Communication:** Information systems enable the seamless exchange of information within and between organizations. This can involve email, messaging, video conferencing, and more.
- **Decision Support:** Information systems provide critical support for decision-making at various levels within an organization. They help analyze data, generate reports, and assist in strategic planning.
- **Automation:** Many routine and repetitive tasks are automated through information systems, improving efficiency and reducing human error. This includes tasks like payroll processing, inventory management, and customer relationship management.
- **Security:** Information systems play a vital role in safeguarding sensitive data and

ensuring the confidentiality, integrity, and availability of information. This is crucial to protect against cyber threats and data breaches.

2. IMPACT OF INFORMATION SYSTEMS

The pervasive use of information systems has transformed our world in several ways [24]:

- Business Transformation: In the business world, information systems have revolutionized operations, enabling real-time data analysis, improved customer service, and global connectivity. E-commerce, for instance, has changed the way companies market and sell their products.
- Healthcare: Information systems have enhanced patient care through electronic health records, telemedicine, and data-driven research. This has led to better diagnosis and treatment.
- Education: E-learning platforms, online resources, and virtual classrooms have made education accessible to a global audience, revolutionizing the learning process.
- Government: Governments use information systems for efficient public service delivery, data analysis, and communication with citizens. E-government initiatives have streamlined bureaucratic processes.
- Social Interaction: Social media and online communities have connected people worldwide, fostering new forms of social interaction, information sharing, and activism.
- Entertainment: The entertainment industry relies heavily on information systems for content creation, distribution, and audience engagement, as seen in streaming services and video games.

3. THE SIGNIFICANCE OF BIG DATA

In the Information Systems domain, data has always been a foundational element. However, the scale, variety, and velocity of data today dwarf what was previously imaginable. The term "Big Data" signifies the magnitude of this paradigm shift. Big Data is not merely a quantitative expansion; it is a qualitative transformation that transcends traditional databases and technologies, impacting every facet of IS. This paradigm shift underscores the importance of delving into Big Data research within Information Systems [25].

3.1 Big Data Research is Significant for Several Reasons

3.1.1 Decision support and innovation

Big Data empowers organizations to make data-driven decisions and unlock new opportunities. The ability to process and analyze vast datasets in real-time has fueled innovation in industries ranging from healthcare to finance.

3.1.2 Competitive advantage

Organizations that harness the potential of Big Data gain a significant competitive advantage. Understanding market trends, consumer behavior, and operational efficiency through data analytics is essential for staying relevant in today's fast-paced world.

3.1.3 Societal impact

Big Data research extends beyond the corporate world. It plays a crucial role in addressing complex societal challenges, such as healthcare management, disaster response, and environmental sustainability.

3.2 The Historical Evolution of Big Data Research

The concept of Big Data can be traced back to the early days of computing when the volume of data was determined by the constraints of hardware. However, it was not until the 21st century that Big Data research gained substantial momentum, owing to several key developments [26,27]:

3.2.1 Technological advancements

The exponential growth in computing power, storage capacity, and the emergence of distributed computing frameworks, such as Hadoop, created the infrastructure needed to handle Big Data.

3.2.2 Internet and social media

The proliferation of the internet and the rise of social media platforms led to an explosion of user-generated data, highlighting the potential of

Big Data analytics for understanding human behavior.

3.2.3 Industry adoption

As businesses recognized the value of Big Data, they invested heavily in analytics, leading to the rapid expansion of the field.

3.2.4 Academic interest

Researchers in the field of Information Systems began to explore Big Data's potential and challenges, sparking a wave of academic publications, conferences, and collaboration between academia and industry.

4. AVENUES OF EXPLORATION IN BIG DATA RESEARCH

Big Data research in Information Systems is a dynamic and multifaceted field encompassing various avenues of exploration, including but not limited to [28,29]:

Data Analytics and Mining: Investigating advanced techniques for extracting valuable insights from large, complex datasets, including predictive analytics, machine learning, and data mining.

Data Management: Addressing challenges related to data storage, retrieval, and security in the context of Big Data, often utilizing NoSQL databases and distributed file systems.

Privacy and Ethics: Examining the ethical implications of Big Data, including issues related to privacy, security, and the responsible use of data.

Business Intelligence: Exploring how organizations can harness Big Data to improve decision-making, optimize operations, and gain a competitive edge.

Industry-Specific Applications: Investigating sector-specific applications of Big Data, such as healthcare informatics, financial analytics, and smart cities.

Technology and Infrastructure: Advancing the technological infrastructure needed to support Big Data, from cloud computing to edge computing.

5. PROS AND CONS

Big data research in information systems holds significant promise, but it also comes with several perils and challenges. Here are some of the perils and promises associated with big data research in this field [30-32]:

Promises:

- Data-Driven Insights: Big data research allows for the extraction of valuable insights from vast and diverse datasets. This can help in making data-driven decisions and enhancing business processes.
- Predictive Analytics: With large datasets, it becomes possible to develop sophisticated predictive models, which can be applied to areas like demand forecasting, fraud detection, and customer behavior analysis.
- Improved Personalization: Big data can help organizations tailor their products and services to individual customer preferences, leading to improved customer satisfaction and loyalty.

- Efficient Operations: Organizations can optimize their operations by analyzing data from various sources, leading to cost reductions and improved efficiency.
- Innovative Applications: Big data research can foster innovation, enabling the development of new products, services, and business models.

Perils:

- Data Privacy and Security: The collection and storage of large amounts of personal and sensitive data can raise significant privacy and security concerns. Data breaches and misuse of data can have severe consequences.
- Data Quality: The accuracy and reliability of data can be a challenge, and inaccuracies or biases in the data can lead to incorrect conclusions and actions.
- Ethical Concerns: Big data research can inadvertently perpetuate bias, discrimination, and inequality, especially if biased data is used to make decisions. This can have social and ethical implications.
- Regulatory Compliance: Regulations like GDPR and CCPA have imposed strict requirements on data handling and storage. Non-compliance can lead to legal issues and financial penalties.
- Infrastructure and Resource Challenges: Managing and processing big data require

significant infrastructure and resources. This can be costly and complex, especially for smaller organizations.

- Lack of Expertise: There's a shortage of professionals with the skills and knowledge required for effective big data research and analysis.
- Overwhelming Amounts of Data: The sheer volume of data can be overwhelming, making it challenging to find relevant information and extract actionable insights.
- Data Silos: Data may be stored in various departments or systems within an organization, leading to data silos that hinder comprehensive analysis.
- Interoperability: Integrating data from various sources and systems can be technically challenging, especially when dealing with legacy systems.
- Data Retention and Governance: Deciding what data to retain, how long to keep it, and how to govern its use and disposal are complex issues.

6. CONCLUSION

Big Data research in Information Systems stands at the forefront of modern knowledge creation, offering a multitude of opportunities and challenges for academics, practitioners, and society at large. As this introduction illustrates, the significance of Big Data, its historical evolution, and the diverse avenues of exploration within this field make it an intellectually stimulating and practically impactful area of study. This frontier of knowledge is not only reshaping the way organizations operate but also illuminating the path toward a more data-driven, innovative, and ethically conscious future.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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