

# The Role of Big Data and Artificial Intelligence in Decision Support

Yanjin Zhu

Faculty of Science, University of Bristol, Bristol, United Kingdom

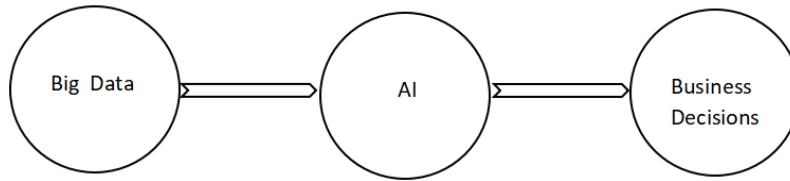
tv23572@bristol.ac.uk

**Abstract.** The 21st century is the digital age, and big data and artificial intelligence (AI) have become key drivers of innovation and development across industries. Applications for big data and AI are transforming into numerous sectors worldwide. This paper provides an overview of the definitions and characteristics of big data and AI, with a focus on the importance of Big Data Analytics (BDA) and AI in decision support. It offers valuable insights and data-driven decision-making for businesses while exploring the interplay between big data and AI in decision support. Taking the retail industry as an example, big data and AI can quickly analyze and process patterns and correlations hidden within massive datasets, enhancing the efficiency and accuracy of decision-making processes while reducing management and operational costs. They play a critical role in planning future product and service decisions. Through these examples, it is evident that big data and AI not only jointly promote development in these fields but also reshape the world around us. This paper aims to provide more accurate and comprehensive recommendations for the development of related industries and decision support.

**Keywords:** Big data, data analytics, data management, artificial intelligence, decision-making.

## 1. Introduction

The concept of BDA was first proposed in 2008. BDA is not simply an accumulation of numbers and information. It typically refers to a collection of information that is so large, rapidly growing, and complex that it cannot be collected, categorized, and analyzed within an acceptable time frame using traditional computer software and hardware tools. They typically have four characteristics: large volume, high variety, rapid generation, and enormous value with low density [1]. The most sought-after resource in the digital age is data [2]. As digital technology can contribute more profits and provide more opportunities for innovation to enterprises, an increasing number of traditional companies are undergoing digital transformation, leading to explosive growth in the big data market [3]. A report by the McKinsey Global Institute (MGI) shows that with the development of the Internet of Things, the application of BDA will also experience rapid growth [4]. Big data has permeated every aspect of the economy, society, environment, and health. These data hold immense potential to drive economic innovation and transformation. Extracting valuable insights from the vast ocean of data can provide robust support for decision-making across all sectors. Organizations can have real benefits from the organization-generated data if they combine it with other types of data [5]. There have been instances where with proper analytics, big data reveals useful insights and becomes a critical factor in almost every industry [3]. According to studies, one of the biggest benefits of BDA is that it helps organizations make better decisions. Roughly 16 percent stated they were better equipped to support the industry's main strategic goals, and about 10% said their customer connections had improved [6]. Disruptive digital technological innovation has the potential to dramatically alter the corporate landscape [7]. Big data is the foundation of all AI, providing the powerful data processing and analysis capabilities that AI relies on. AI uses technologies such as data mining, machine learning, and deep learning to extract valuable information from massive amounts of complex data, providing support for the training and optimization of AI models.



**Figure 1.** The interrelationship between big data, artificial intelligence, and decision-making

The relationship shown in Figure 1 demonstrates that artificial intelligence can support business decisions, but artificial intelligence and machine learning rely on big data as their source of information. In addition, AI relies on big data to train and optimize its models. By analyzing massive amounts of data, AI can discover patterns, extract features, and make intelligent decisions based on this information. In the medical field, doctors can use BDA and AI to assist in diagnosing diseases and providing treatment recommendations. It can even perform precise analyses based on personal medical history, diet, lifestyle habits, and other factors to formulate personalized medical plans. For logistics companies, the use of artificial intelligence and big data technologies can effectively optimize traditional processes, improve the resilience of logistics systems, and enhance operational efficiency [8]. Big data and AI have become important drivers of innovation and development in the industry. The research findings indicate that artificial intelligence has immeasurable value in terms of the prospects for successful collaboration between senior management and machines. It is invaluable in highlighting the prospects for successful collaboration between management and machines.

In addition, AI technology helps decision-makers improve efficiency, accuracy, and innovation. People can use the predictive modelling capabilities of AI to help managers simulate how potential action plans will affect various parts of the organization. AI technology can also be applied to risk management and risk assessment, which is in line with the system's quality management requirements. The use of AI technology in commercial decision-making has the potential to transform the way organizations operate and formulate strategies completely. By enhancing efficiency, accuracy, and innovation, AI empowers businesses to harness the power of data and make informed decisions in a dynamic and competitive landscape [7]. Numerous studies have looked at how behavior, decision-making, and IQ interact. According to research, people can effectively reduce subjective judgments and biases with the help of artificial intelligence technology, thereby improving the accuracy of decision-making. By leveraging data-driven insights and advanced analytical capabilities, AI technologies help mitigate cognitive biases and contribute to more reliable decision outcomes [9]. Based on this, this paper studies the role of big data and AI in decision support, revealing the relationship between the two and providing case studies for managers to refer to.

## **2. The Fundamental Role of Big Data in Decision Support**

### **2.1. Providing Comprehensive Decision-Making Basis**

Scholar Peter Drucker highlighted the importance of quantifiable data in management. The basis for measuring management success lies in multi-dimensional data analysis, such as company operational data, production volume, external market supply and demand data, financial data, regional market trends, and supply chain data. These data points converge to form a data foundation. By conducting data analysis and generating reports, bottlenecks and inefficiencies in business processes can be identified, helping decision-makers optimize resource allocation, improve efficiency, and reduce costs. For example, by analyzing production data, companies can optimize production processes and reduce waste; by analyzing sales data, organizations can enhance inventory management practices and prevent the accumulation of surplus inventory.

Additionally, real-time decision support through big data is another advantage. Its real-time processing capability enables decision-makers to obtain analysis results in real time, thereby helping managers respond swiftly. In a highly competitive market environment, this real-time analysis assists

decision-makers in promptly formulating strategies, seizing business opportunities, or addressing crises, thereby mitigating risks. For instance, construction companies can adopt a big data-driven decision-making approach to analyze historical project data, conduct key factor analyses on projects that previously experienced delays, and adjust project plans based on the analysis results, thereby effectively reducing the risk of project delays.

## **2.2. Uncovering Potential Decision-Making Clues to Address Complex Decision-Making Issues**

BDA can reveal correlations and trends within data. By conducting statistical analysis and data mining on big data, managers can identify patterns and trends hidden within the data, thereby predicting future trends and changes. Massive amounts of data must be processed according to specific rules to be effectively utilized. Data processing typically involves data collection, filtering, correlation analysis, artificial intelligence calculations, and interpretation of results. When necessary, computational models may be established based on data correlations, temporal sequences, and factors influencing data changes to enhance the accuracy of data analysis. Managers then study and refine the analysis results, ultimately transforming them into valuable information and conclusions to assist in developing action plans, thereby improving the accuracy and efficiency of decision-making. Trend-based analysis results can help managers assess and predict future risks and trends, promptly identify potential future risks and changing trends, and establish corresponding risk prevention measures. This facilitates managers in finding a balance between risk and reward when formulating action plans.

In addition, big data can help managers identify new development opportunities and provide new innovative ideas, enabling them to focus more on innovation and competitiveness in decision-making, thereby expanding into new business areas. For example, by leveraging big data's forward-looking predictions and trend analyses, managers can gain insight into consumer spending trends. From this, managers can identify new market demands, thereby promoting timely research and development and production of new products to capture market opportunities promptly.

In summary, big data analysis provides managers with a wealth of information, deeply reveals the correlations between data, analyzes future trends, and continuously optimizes computational models to achieve real-time updates of predictive results, thereby helping managers make timely and accurate decisions.

## **3. The Core Role of AI in Decision Support**

Obtaining data is easy, but dry data requires in-depth analysis to generate value. Even with data in hand, human analytical and judgmental abilities alone cannot extract important information from this data, let alone make accurate decisions. The development of artificial intelligence has changed traditional decision-making methods, making data analysis faster and more accurate, which precisely proves the important role of artificial intelligence in decision support.

### **3.1. Handling Complex Decision-Making Problems**

AI technology based on data analysis has become a trend. AI can automatically complete complex tasks according to set conditions. AI and machine learning have been used to process large data sets and discover patterns, and to make predictions with minimal human intervention [10]. For example, in the field of healthcare, AI can be used to identify images in medical imaging to assist medical personnel in diagnosing patients' conditions. In addition, AI can continuously learn from data, enabling enterprises to adapt to a constantly changing environment. Machine learning algorithms can be used to identify trends, handle complex calculations, and automatically generate optimal solutions to support decision-making by managers. For example, in epidemic prevention and prediction, AI can analyze historical data to precisely identify high-risk patient groups for specific diseases or epidemics, helping medical institutions to develop preventive measures in advance.

### **3.2. Improving Decision-Making Efficiency and Accuracy**

Experience and intuition are the primary methods of traditional decision-making. This method is not only inefficient and inconsistent but also challenging to guarantee accuracy and objectivity. Automation is where intelligence excels, particularly in routine decision-making and iterative processes [11]. Based on this advantage, people can develop different models and algorithms as needed to improve data processing and analysis and provide accurate decision support. In the field of marketing, it can help companies analyze customer consumption habits and interests, and promptly and accurately push product information that consumers are interested in, thereby increasing consumer repurchase rates. In the field of meteorology, AI can also predict disaster risks and assist governments in deploying prevention and control measures in advance.

## **4. Analysis of Actual Application Areas**

### **4.1. Business Management Decisions**

Big data and AI can help businesses optimize supply chain decisions. For example, big data can track inventory, logistics, and demand data, while AI can optimize procurement volumes and delivery routes. According to publicly available data, JD Logistics' supply chain technology revenue grew by 25% in 2024, with the application of 'digital twin' AI technology to warehouse layout optimization and end-to-end supply chain management, reducing sorting costs by approximately 20%. United Parcel Service, Inc. (UPS) saves \$400 million annually in fuel costs through its route optimization system, directly supporting its 8%-10% B2B business profit margin. Additionally, AI has widespread application in strategic investment decisions, such as analyzing industry trends, policy changes, and corporate financial data to provide recommendations for investors and screen potential projects for venture capital institutions.

### **4.2. Public Policy Decision-Making**

AI brings new opportunities and challenges to the optimization of public services. By making reasonable use of AI technology, people can improve the quality and efficiency of public services and create a better life for the public. For example, artificial intelligence has been widely applied in urban traffic management to alleviate traffic congestion. By installing road monitoring equipment, real-time traffic flow data from different times, road locations, and weather conditions is transmitted to data centers and traffic control centers. Based on the results of artificial intelligence analysis, traffic control measures are swiftly implemented to alleviate traffic pressure. The accumulated data further provides a data foundation for urban planning engineers. By leveraging AI to conduct systematic and scientific analyses of factors adversely affecting traffic, they can even consider various factors such as government agency economic conditions, project scope, and schedule, screen and compare options, and provide optimal solutions, thereby assisting urban planning engineers in making more scientific and reasonable decisions.

In addition, artificial intelligence can quickly collect and process satellite images, surveillance videos, and various hydrological and meteorological monitoring data. People can use powerful algorithms for analysis. This technology is widely used in the field of emergency management, such as early warning and rescue work for sudden natural disasters such as earthquakes, volcanoes, tsunamis, floods, and extreme weather. It plays a role in disaster prevention, mitigation, and protecting people's lives and property. For example, prolonged heavy rainfall can easily trigger floods and landslides. AI can analyze historical and real-time monitoring data to provide real-time updates on river water levels, quickly assess disaster risk levels, predict the impact areas of floods and landslides by analyzing surrounding terrain and population distribution, and issue disaster warnings. When disasters occur, AI can also use surveillance footage to precisely locate trapped individuals and provide rescue teams with the optimal rescue routes.

Another example is during earthquakes. Emergency management departments can use AI to promptly report earthquake intensity and epicenter locations, classify the affected areas, guide rescue personnel in rationally allocating rescue resources, and formulate different rescue measures. AI can also transfer injured personnel to hospitals for treatment via the optimal routes and in the shortest possible time. When adverse weather conditions form, AI systems can promptly issue warnings and provide detailed safety information to minimize casualties and property losses. In the field of natural disaster emergency management, the integration of big data and artificial intelligence has demonstrated significant capabilities and application potential.

### **4.3. Personal Lifestyle Decisions**

AI is also being applied to the health management industry, with various types of devices capable of real-time data monitoring constantly emerging. Among these, wearable devices such as fitness trackers enable users to comfortably monitor their own data (heart rate, blood pressure, blood oxygen levels, etc.) at home, addressing issues such as discontinuous health monitoring data and the time-consuming and challenging data collection process for health management professionals. This enables health management professionals to analyze the collected information, issue early warnings for abnormal data, and recommend exercise, diet, and wellness plans to prevent more severe symptoms from developing.

## **5. Conclusion**

This paper defines big data and its main characteristics, explores the important role of big data and AI in human decision-making, and discusses the interrelationship between big data and AI. Additionally, it introduces key technologies and methods such as data statistics and analysis, machine learning, and AI, and provides detailed examples of applications in industries such as healthcare, finance, supply chain management, public services, weather, and earthquake prediction. It demonstrates how big data, and AI can support organizational and individual decision-making in various scenarios, including optimizing business processes, predictive prevention, enhancing decision-making efficiency and accuracy, uncovering potential decision-making clues, and addressing complex decision-making challenges.

Data is the foundation, and AI algorithms are the key. While big data and AI can play a significant role in decision-making, this does not negate the importance of human involvement. Algorithms require human intelligence for discovery and innovation, necessitating continuous optimization of algorithmic models to enhance device performance and develop superior computer algorithmic programs. This is essential to adapt to the growing volume of data and increasingly complex decision-making requirements.

Future efforts must continue to deepen human-machine integration. Big data and AI remain in a period of rapid development, requiring ongoing research to address emerging challenges and anticipate future trends. Continuous algorithm development, leveraging machine learning and other methods, is essential to create faster and more precise algorithm models capable of meeting increasingly complex decision-making demands.

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