NOLEGEIN Journal of
Human Resource Management & Development

ISSN: 2581-9461
Volume 5, Issue 2, 2022
DOI (Journal): 10.37591/NJHRMD

http://mbajournals.in/index.php/JoHRMD/index

Review NJHRMD

The Use of Big Data Analytics in Operations Research: Challenges and Opportunities

Vidhi Dhyani*

Abstract

Organizations are producing exponentially more data as a result of the development of technology and data. This big data presents a significant opportunity for organizations to gain insights and optimize their operations, particularly in the field of operations research (OR). Big data analytics (BDA) is a rapidly growing field that focuses on the use of advanced techniques and technologies to extract insights from large and complex datasets. The integration of BDA into OR has the potential to revolutionize the field, providing organizations with more accurate and comprehensive insights into their operations. Big data analytics' primary goal is to transform enormous amounts of raw data into actionable insights that businesses can use to enhance their operations and make better decisions. As the volume of data generated by organizations continues to grow, big data analytics is likely to become even more critical to the success of OR initiatives. Big data analytics is a critical component of the field of operation research (OR) because it allows organizations to make more informed decisions based on real-time data and insights. However, there are also several challenges associated with the use of BDA in OR, including the quality and availability of data and the complexity of BDA algorithms. In this study, we review the key applications of BDA in OR, the challenges associated with its use, and the future research directions in this field.

Keywords: Operations research, big data analytics, data, optimization, decisions

INTRODUCTION

Operations research (OR) is a field that uses mathematical and quantitative methods to solve complex problems and make better decisions. OR has a long history of contributing to the advancement of various industries, including manufacturing, transportation, and finance. With the growth of big data, the use of OR has become increasingly relevant as organizations seek to extract insights and optimize their operations [1].

Big data analytics (BDA) is a rapidly growing field that focuses on the use of advanced techniques and technologies to extract insights from large and complex datasets. BDA has the potential to provide organizations with new and innovative solutions to a wide range of problems, from production planning and scheduling to demand forecasting and optimization. The integration of BDA into OR has the potential to revolutionize the field, providing organizations with more accurate and comprehensive insights into their operations [2].

***Author for Correspondence**
Vidhi Dhyani
E-mail: vidhi.dhyani18@gmail.com

Student, Department of Commerce, Graphic Era, Clement Town, Dehradun, Uttarakhand, India

Received Date: February 13, 2023
Accepted Date: February 18, 2023
Published Date: March 24, 2023

Citation: Vidhi Dhyani. The Use of Big Data Analytics in Operations Research: Challenges and Opportunities. NOLEGEIN Journal of Human Resource Management & Development. 2022; 5(2): 1–4p.

Applications of BDA in OR

One of the key applications of BDA in OR is demand forecasting. Accurate demand forecasting is critical for organizations looking to optimize their operations, as it enables them to make informed

decisions about production planning, inventory management, and pricing. BDA can be used to analyse large and complex datasets, such as sales data, demographic data, and weather data, to improve the accuracy of demand forecasting [3, 4].

Another application of BDA in OR is optimization. Optimization involves finding the best solution to a problem by considering a set of constraints and objectives. BDA can be used to analyse large and complex datasets to identify patterns and relationships that can be used to optimize operations. For example, BDA can be used to optimize transportation routes, production schedules, and inventory levels [5].

BDA can also be used in the field of predictive maintenance, where it can be used to analyse large amounts of sensor data from equipment to identify patterns and predict when maintenance is needed. Predictive maintenance can help organizations to minimize equipment downtime, reduce maintenance costs, and improve overall operational efficiency [6].

The value creation is impacted by the adoption of big data analytics by organisations, and the critical antecedents of big data analytics usage within an organisation are influenced by the rate at which an organization's environmental and technological factors change, and these factors are indirectly influenced by top management's support.

To improve the operational effectiveness of the business, supply chain analytics can be defined as the use of big data analytics to the supply chain. By enabling data-driven decisions at the tactical, operational, and strategic levels, this might be accomplished. The supply chain analytics architecture is defined from a resource-based organisational perspective by the intersection of three resource sets: IT-enabled planning resources, performance management resources, and data management resources [7, 8].

CHALLENGES AND FUTURE RESEARCH DIRECTIONS

While BDA has the potential to revolutionize OR, there are also several challenges associated with its use. One of the main challenges is the quality and availability of data. In order to extract meaningful insights from big data, organizations must have access to high-quality and relevant data. Another challenge is the complexity of BDA algorithms, which can be difficult to understand and interpret.

The complexity of BDA algorithms is particularly challenging in the field of OR, where the goal is often to make decisions based on the insights generated by these algorithms. This requires a deep understanding of the algorithms and their outputs, which can be difficult for many organizations. In order to overcome this challenge, organizations need to invest in the development of tools and methods that make it easier to understand and interpret BDA algorithms [9].

Another challenge associated with the use of BDA in OR is the need for specialized skills and expertise. BDA involves the use of advanced techniques and technologies that require specialized knowledge and skills. Organizations need to invest in training and development programs to ensure that they have the necessary skills and expertise to effectively use BDA in OR.

Using Big Data Analytics to Acquire Critical Insights

It is crucial for businesses to get the right insights from big data analytics, and it is crucial that the right department has access to this information. In big data analytics, effectively bridging this gap is a significant problem [10].

Lack of understanding will lead to unsuccessful data and analytical process deployments within a company/brand. By 2018, the United States alone may experience a shortage of between 140,000 and 190,000 individuals with advanced analytical abilities as well as 1.5 million managers and analysts who are knowledgeable about how to use the analysis of big data to make wise judgements [11].

All of this indicates that while there will be numerous job openings in this industry, there will be very few professionals who genuinely possess the knowledge to successfully fill these roles. The skill gap will gradually decrease as data practitioners gain greater expertise through continued work in the industry.

Despite these challenges, the integration of BDA into OR is an exciting development with enormous potential. The future research directions in this field are likely to focus on the development of new and more advanced BDA techniques, the improvement of data quality and availability, and the development of tools and methods that make it easier to understand and interpret BDA algorithms [12].

Big Data is a rapidly expanding industry. With its potential use in numerous organisations, it is becoming more and more popular. So, whether you are searching for a lengthy, steady career with good pay, working in this industry is one of the safest bets.

Cloud storage companies like Microsoft Azure, Google Cloud, AWS, and others will dominate the big data storage market as data continues to develop and grow. This will provide businesses more room to grow and become more efficient. This also implies that there will be an increase in the number of candidates recruited to handle this data, which translates to an increase in the number of job prospects for "Big Data Engineers" to manage a company's database and enormous amount of data. According to statistics, businesses are implementing this new technology, and Big Data will rank among the finest technologies in the future [13].

Future Research

There are several areas where future research could be directed to advance our understanding and capabilities in this field:

Integration of Big Data Analytics with Traditional OR Techniques

Researchers can explore how big data analytics can be integrated with traditional OR techniques, such as mathematical modelling, optimization, and simulation, to improve the accuracy and efficiency of decision-making.

Real-time Analytics

Future research can focus on developing methods for real-time big data analytics, enabling organizations to make decisions based on up-to-the-minute data and insights.

Multi-objective Optimization

Researchers can investigate the integration of big data analytics with multi-objective optimization techniques, to help organizations balance conflicting objectives and make trade-off decisions.

Privacy and Security

As big data analytics increasingly involves sensitive and personal information, future research should focus on developing privacy-preserving methods for big data analytics and ensuring the security of big data systems.

Interdisciplinary Research

There is a growing need for interdisciplinary research that brings together experts from diverse fields, such as computer science, mathematics, statistics, and management, to tackle the complex problems posed by big data analytics.

Application Domains

Future research could focus on the development of domain-specific big data analytics solutions for various industries, such as finance, healthcare, and transportation, to support decision-making and improve operations in these industries [14, 15].

CONCLUSION

In conclusion, the integration of BDA into OR has the potential to revolutionize the field, providing organizations with more accurate and comprehensive insights into their operations. BDA can be used to solve a wide range of problems in OR, from demand forecasting and optimization to predictive maintenance. Big Data is enabling the sector to advance to a new level. But without someone to examine the data and uncover its underlying patterns, it is useless. Businesses seek to gain insights from Big Data; thus they are constantly looking for qualified people in this field who can decipher its hidden meanings. Businesses hope to provide better client services with the aid of big data, which can contribute to higher profits. For the majority of businesses, improved customer experience is the main objective. Other objectives include better target marketing, cost cutting, and increased operational efficiency.

Big data technologies enable significant cost savings while assisting businesses in storing enormous volumes of data. Hadoop and cloud-based analytics are examples of such technology. They aid organisations with information analysis and decision-making improvement The need for better security is also highlighted by data breaches, which technology applications can address. Using BDA in OR is not without its difficulties, but they can be solved by investing in research, development, and training. The future of OR is likely to be greatly impacted by the continued growth and development of BDA, and organizations that embrace this technology will be well positioned to take advantage of its many benefits.

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