OPEN ACCESS

Volume: 12

Special Issue: 1

Month: February

Year: 2025

P-ISSN: 2321-788X

E-ISSN: 2582-0397

Received: 24.12.2024

Accepted: 13.01.2025

Published: 28.02.2025

Citation:
Preetham, M. Shanu, and S. Janani. "The Role of Big Data Analytics in Enhancing Decision-Making in Operations Management." *Shanlax Inernational Journal of Arts, Science and Humanities,* vol. 12, no. S1, 2025, pp. 398-408.

DOI:
https://doi.org/10.34293/sijash.v12iS1-Feb.9986.

The Role of Big Data Analytics in Enhancing Decision-Making in Operations Management

M. Shanu Preetham
I MBA, School of Management
Dwaraka Doss Govardhan Doss Vaishnav College, Chennai, Tamil Nadu

S. Janani
I MBA, School of Management
Dwaraka Doss Govardhan Doss Vaishnav College, Chennai, Tamil Nadu

Abstract

In today's fast-paced business environment, Big Data Analytics (BDA) plays a critical role in enhancing decision-making in Operations Management (OM). The integration of data-driven insights enables companies to optimize supply chains, improve demand forecasting, and enhance operational efficiency. This study explores the applications of BDA in OM, focusing on its impact on industries such as manufacturing, logistics, and retail. By leveraging machine learning, artificial intelligence, and predictive analytics, companies can minimize risks, reduce costs, and enhance productivity. The research highlights key challenges, including high implementation costs, data security concerns, and the need for skilled professionals. Through a mixed-methods approach, including surveys and interviews with industry experts, the study provides a comprehensive analysis of BDA's effectiveness in improving decision-making. The findings indicate a strong positive perception of BDA's impact on efficiency, with industries prioritizing AI and machine learning for future adoption. However, significant investment in technology and infrastructure remains a major barrier. The study concludes with recommendations for businesses, particularly SMEs, on adopting BDA with minimal resources to gain a competitive advantage.

Keywords: Big Data Analytics; Data-Driven Insights; Big Data Analytics Capabilities; Decision-Making; Circular Economy; Manufacturing Firms; Predictive Analytics

Introduction

In today's fast-paced and highly competitive business environment, organizations are increasingly relying on Big Data Analytics (BDA) to enhance decision-making in Operations Management (OM). Operations management involves the planning, organizing, and controlling of business activities to ensure efficiency, productivity, and cost-effectiveness. With the rapid digital transformation, companies generate vast amounts of data from various sources, such as enterprise resource planning (ERP) systems, Internet of Things (IoT) devices, customer interactions, social media, and market trends. Harnessing this data effectively has become crucial for optimizing operations, improving supply chain management, and gaining a competitive advantage.

Big Data Analytics involves the use of advanced technologies such as machine learning, artificial intelligence (AI), cloud computing, and predictive modelling to process large datasets and extract meaningful insights. These insights empower decision-makers to make data-driven and strategic choices, reducing uncertainty and enhancing operational efficiency. For example, predictive analytics enables companies to forecast demand fluctuations, allowing them to adjust production schedules, manage inventory effectively, and minimize waste

One of the most significant applications of big data analytics in operations management is in supply chain optimization. By analysing historical data and external factors such as weather conditions, geopolitical events, and consumer behaviour, companies can enhance logistics, reduce transportation costs, and streamline distribution networks. Additionally, big data enables the implementation of just-in-time (JIT) inventory systems, ensuring that resources are available when needed without overstocking or shortages.

Moreover, big data analytics improves quality management and process optimization. In manufacturing industries, for instance, sensors and IoT-enabled devices collect real-time data on machine performance and product quality. This data allows companies to detect defects, predict equipment failures, and implement predictive maintenance strategies, reducing downtime and operational costs.

By exploring these best practices and challenges, this paper aims to provide a comprehensive understanding of how organizations can effectively integrate big data analytics into their operations supply chain activities, ultimately enhancing efficiency and in their organizational decision-making process.

Review of Litreature

Jeble, Kumari & Patil (2017) – Role of Big Data in Decision Making

This study highlights how big data analytics enables firms to gain a competitive edge by uncovering insights, patterns, and associations. It emphasizes analytics applications in supply chain, web, and social media data, offering a framework to help SMEs develop analytics capabilities and compete efficiently.

Addo-Tenkorang & Helo (2016) – Big Data Applications in Supply Chain Management

The paper explores big data trends in supply chain management, introducing a "Big Data II" (IoT-Value-Adding) framework. It identifies key attributes: variety, velocity, volume, veracity, and value, emphasizing how big data supports strategic decision-making, improves return on investment, and enhances competitive advantage in operations.

Dey & Bhattacharyya (2016) – Big Data Analytics in Supply Chain Management

The study examines big data's role in Indian manufacturing supply chains, optimizing demand forecasting, logistics, and inventory management. It highlights real-time data from sensors and RFID for improved performance and predictive analytics for bottleneck identification, ultimately enhancing operational efficiency in Indian companies.

Lamba (2019) – Future of Big Data Analytics in Operations Management

This article explores the future impact of AI, IoT, and Industry 4.0 on operations management. It highlights how smart factories will integrate big data analytics, enabling real-time decision-making, automation, and enhanced efficiency in supply chain and manufacturing operations.

Bansal & Garg (2018) – Big Data in Indian Logistics Companies

The paper discusses how Indian logistics firms use big data for route optimization, warehouse management, and fuel efficiency. Geospatial data and traffic patterns enable improved distribution strategies, reducing operational costs and delivery times, enhancing supply chain performance.

Waller & Fawcett (2013) – Big Data in Forecasting and Demand Planning

The study highlights predictive analytics' role in demand forecasting, helping firms reduce stockouts and overstock situations. By analysing historical and real-time data, including weather and social media trends, companies can improve forecasts, ensuring better inventory management and market responsiveness.

Ravi & Saha (2016) – Challenges in Implementing Big Data Analytics in India

The article examines barriers to big data adoption in India, including inadequate infrastructure, data security concerns, and a shortage of skilled professionals. SMEs struggle with high implementation costs, while regulatory compliance remains a major challenge for data-driven decision-making.

Patel & Trivedi (2019) – Big Data's Impact on Indian Retail Operations

The study explores how Indian retailers use big data for inventory management, customer behavior analysis, and sales forecasting. By personalizing promotions and streamlining supply chains, retailers enhance customer satisfaction, reduce waste, and improve operational efficiency.

McAfee & Brynjolfsson (2012) – "Big Data: The Management Revolution"

This study highlights how data-driven decision-making enhances productivity and profitability. The authors argue that companies leveraging big data analytics outperform competitors by making evidence-based strategic decisions rather than relying on intuition. They emphasize the need for strong data governance and analytics capabilities to drive business success.

Lee (2017) – "Big Data Analytics in Smart Manufacturing"

The paper explores the application of big data analytics in manufacturing, particularly in predictive maintenance and quality control. The authors discuss how real-time monitoring and IoT-enabled sensors improve production efficiency by detecting defects early and minimizing downtime.

Chien et al. (2020) – "Big Data Analytics in Quality Control and Defect Detection"

The article investigates how deep learning and image recognition improve defect identification in manufacturing. The authors highlight the impact of AI-driven analytics on reducing production errors and enhancing product quality.

Gupta & Singh (2019) – "Big Data Analytics in Retail Operations: A Review"

This paper examines the role of big data in retail, focusing on customer behaviour analysis, inventory optimization, and personalized marketing. The authors discuss how retailers leverage AI and machine learning to enhance customer experiences and improve operational efficiency.

Luo & Goh (2017) – "Big Data Analytics in Airline Operations: Challenges and Opportunities"

This article explores how airlines use big data for route optimization, fuel efficiency, and customer experience improvement. The authors highlight the potential of real-time analytics in minimizing delays and enhancing decision-making in airline operations.

Eltamaly & Mohamed (2018) – "Big Data Analytics in Energy Management: A Review"

The paper discusses the role of big data analytics in optimizing energy consumption and improving sustainability. The authors highlight the use of smart grids, predictive analytics, and IoT in energy-efficient operations.

Wang & Wang (2019) – "Big Data Analytics in Financial Services: A Systematic Literature Review"

This study reviews the impact of big data on financial decision-making, fraud detection, and risk management. The authors examine how machine learning and AI improve forecasting accuracy in banking and investment sectors.

Brown & Wyld (2017) – "Big Data Analytics in Public Sector Operations: A Review"

The paper examines how governments use big data analytics to enhance public services, improve policy-making, and optimize resource allocation. It discusses the ethical and privacy concerns associated with large-scale data collection.

Objective of the Study

- To analyse the role of big data analytics in enhancing decision-making in operations and supply chain management.
- To examine how big data improves forecasting, demand planning, and logistics optimization in various industries, including manufacturing, retail, and logistics.
- To explore the impact of big data on operational efficiency by reducing costs, minimizing risks, and improving supply chain resilience.
- To identify the key challenges in implementing big data analytics, particularly in emerging markets like India, including infrastructure limitations, data security concerns, and the need for skilled professionals.
- To assess the future potential of big data technologies, such as artificial intelligence (AI), the Internet of Things (IoT), and predictive analytics, in transforming operations management.
- To provide a conceptual framework for businesses, especially SMEs, to adopt and leverage big data analytics for competitive advantage with minimal resources.

Research Methodology

Research Design

Thus, the study employs a descriptive and exploratory research design in order to assess the impact of big data analytics on decision-making in operation and supply chain management. The descriptive part systematically explains the application of big data in various industries, whereas the exploratory approach focuses on newly developed trends, problems, and emerging technologies (like AI and IoT) in data-driven decision-making.

This research employs a mixed-method approach, defining qualitative and quantitative techniques which ultimately establish a wholistic view of the study. Secondary data from academic journals, industry reports, and case studies were collected to identify the key insights on big data applications, benefits, and barriers. Also collected were primary data via survey and interview of industry experts to give real-world perspectives of big data adoption.

This design enables the study to eventually give an overall understanding of the impact of big data analytics on operational efficiencies. The integration of empirical evidence with real-world applications makes the overall findings more relevant and applicable within business scopes. The study's flexible design also allows for any further changes depending on data availability, which

makes it amenable to each industry environment as well as any emerging research trend in big data analytics.

Data Collection

Primary Data Collection

Interviews

Semi-structured interviews will take place with key stakeholders, including operations managers, supply chain executives, and IT professionals involved in big data analytics adoption. These interviews will offer detailed insights into the challenges, best practices, and practical uses of big data analytics in operations management. The discussions will center on how organizations collect, process, and use big data to improve decision-making, efficiency, and cost savings. The insights gathered will clarify industry-specific implementations, obstacles to adoption, and new trends in data-driven decision-making.

Surveys/Questionnaires

A survey will be given to employees, managers, and decision-makers in organizations that use big data analytics in their operations and supply chain management. The survey will gather information on how much big data is adopted, the challenges faced, the benefits gained, and its overall effect on operational performance. It will include Likert scale questions to assess attitudes and views on big data's role in improving forecasting accuracy, inventory management, risk management, and predicting customer demand. The survey results will provide measurable data to show how big data analytics affects decision-making, helping organizations use their resources better and stay competitive.

Secondary Data Collection

1. Literature Review: A comprehensive review of existing academic research, industry reports, and case studies on role of big data analytics in operations decision making were conducted.
2. Case Studies: Relevant case studies from companies were analysed to understand how big data analytics enhances decision-making in operations management. These cases highlight applications in inventory optimization, demand forecasting, and logistics efficiency, providing practical insights into successful big data integration for improved operational performance and competitive advantage.

Sampling Method

The study employs a convenience and stratified random sampling approach to ensure relevant data collection from professionals experienced in Big Data Analytics in Operations Management. Convenience sampling is used for selecting industry experts, operations managers, and data analysts for interviews, ensuring insights from those actively involved in big data decision-making. For quantitative analysis, stratified random sampling is used to ensure representation from different industries and job roles. This method divides the target population into strata (subgroups) based on predefined characteristics and then selects random samples from each subgroup. For surveys, stratified random sampling is applied to categorize respondents based on industry (e.g., manufacturing, logistics, retail, and IT) and job roles (e.g., decision-makers, analysts, and supply chain managers). The sample size is around from 112 respondents. This method ensures diverse perspectives, improving the study's validity and generalizability across industries.

Data Analysis Techniques

Percentage Analysis

Percentage analysis is used to interpret survey responses by calculating the distribution of responses across different categories. It helps in understanding trends related to big data adoption, challenges, benefits, and perceptions among professionals in operations management. This method provides a clear, visual representation of how various factors influence decision-making, aiding in easy comparison and interpretation of results.

Correlation Analysis

Correlation analysis is applied to examine the relationship between big data analytics and decision-making efficiency in operations management. It identifies the strength and direction of relationships between variables such as:

- Big data usage and operational performance
- Predictive analytics and supply chain efficiency
- Data-driven decision-making and cost reduction

By determining whether these variables are positively or negatively correlated, businesses can optimize data-driven strategies for improved outcomes.

Regression Analysis

Regression analysis is used to assess the impact of big data analytics on decision-making efficiency. This statistical technique helps predict how independent variables (big data tools, analytics adoption, AI integration, etc.) influence dependent variables (decision accuracy, cost savings, productivity, etc.). The results will help in quantifying how much big data analytics contributes to better forecasting, risk mitigation, and resource optimization in operations management.

Results and Discussion

Findings

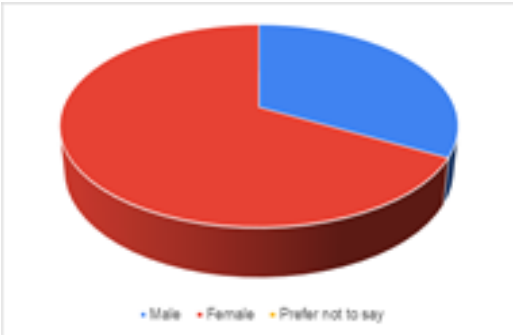

Fig. 1 (Gender)

From the above fig., we infer that a higher participation from Females (67.16%) compared to Males (32.83%), with no respondents preferring not to disclose their gender. This suggests that female perspectives are more prominently represented in the study.

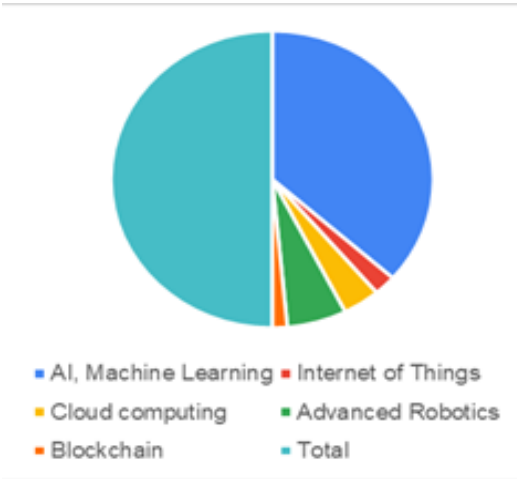

Fig.2(In 5 years, the major adoption would be)

From the above fig.2, we infer that AI and Machine Learning industry has the highest representation, with 73.13% of respondents, highlighting its significant role in adopting Big Data Analytics. Advanced Robotics follows with 11.94%, while Cloud Computing and the Internet of Things account for 7.46% and 4.48%, respectively. Blockchain has the least representation at 2.99%. This distribution suggests that industries heavily reliant on data-driven technologies, especially AI and Machine Learning, are more engaged in leveraging Big Data Analytics for operational decision-making.

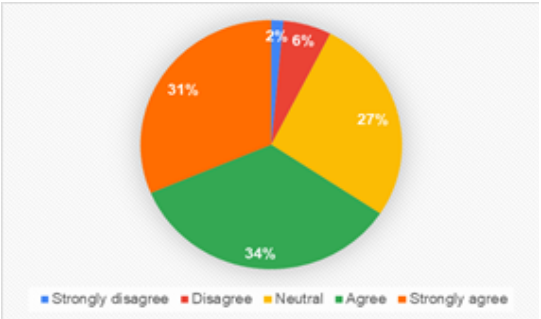

Fig.3 (Big Data Analytics is a crucial component in decision making process)

From the fig.3, it indicates that a significant majority of respondents (65.67%) agree or strongly agree that Big Data Analytics enhances decision-making in operations management. A notable 26.87% remain neutral, suggesting either limited exposure or uncertainty regarding its impact. Only a small fraction (7.46%) disagrees or strongly disagrees, reflecting minimal scepticism. Overall, the data highlights a strong positive perception of Big Data Analytics among respondents.

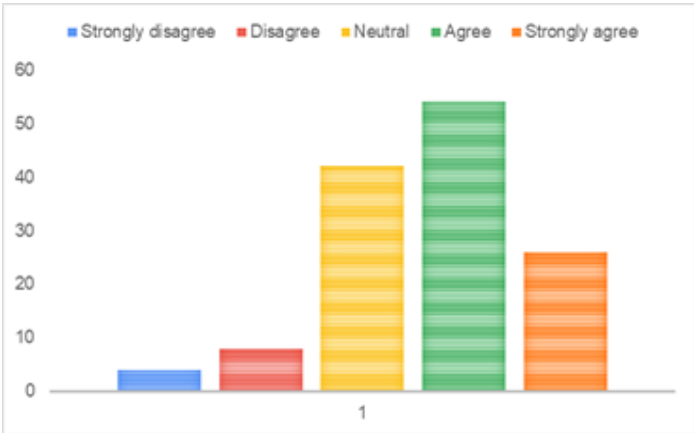

Fig.4 Implementing Data Analytics in Operations require significant investment in technology and infrastructure

From the above figure, we infer that the survey reveals a positive sentiment overall, with a significant majority (over 60%) of respondents agreeing or strongly agreeing with the statement. A substantial portion (around 31%) remained neutral, indicating a lack of strong opinion. Only a small percentage (less than 9%) disagreed or strongly disagreed.

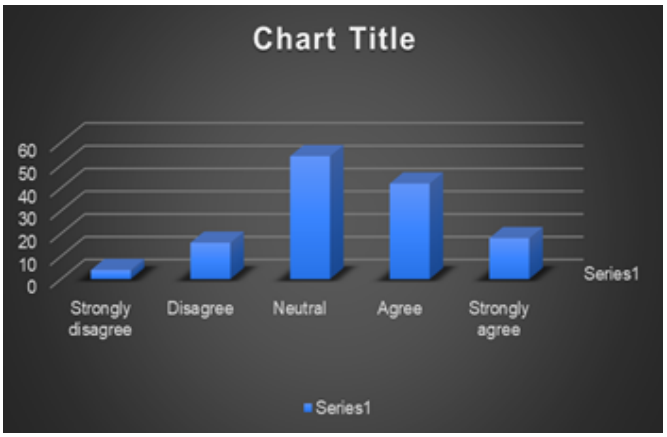

Fig.5(Big Data Analytics expedites the identification of Bottle necks a point of congestion in production system that slows or stops the progress)

From the above figure, a significant portion of respondents neither strongly agreed nor disagreed, suggesting a lack of strong conviction regarding Big Data Analytics' ability to expedite bottleneck identification. While a substantial group agreed, the high neutrality indicates potential uncertainty or a lack of direct experience. This suggests that while Big Data Analytics may have potential, its perceived effectiveness in expediting bottleneck identification isn't universally strong.

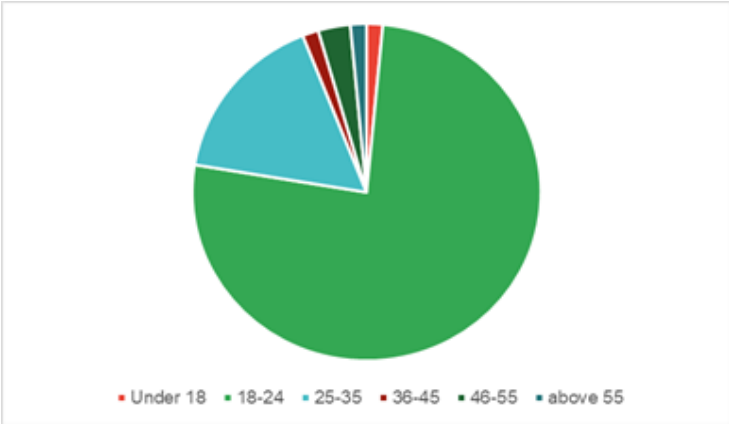

Fig.6(Age of the Respondents)

From the above figure, it states the data overwhelmingly represents the 18-24 age group, comprising over 76% of the sample, indicating a strong skew towards young adults. Conversely, older age brackets are significantly underrepresented, with each accounting for a very small percentage of the total. This age distribution suggests the data primarily reflects the views or characteristics of young adults, limiting its generalization to a broader population.

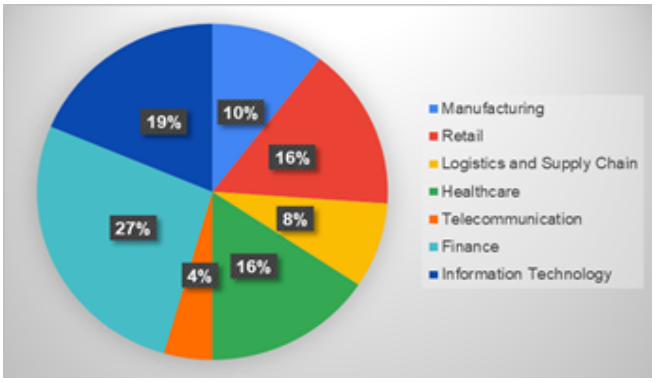

Fig.7 (Occupation/ Field of the Respondents)

The above figure, pie chart depicts the distribution of a subject (likely respondents or data points) across various industries. Healthcare and Manufacturing represent the largest segments, indicating significant engagement or representation within these sectors. Retail and Logistics/Supply Chain show moderate presence, while Finance and Telecommunication have relatively smaller shares. Information Technology appears to have the lowest representation in this distribution.

Correlation Analysis

Correlation analysis is a statistical method used to assess the strength and direction of the relationship between two or more variables. It helps to determine whether an increase or decrease in one variable is associated with an increase or decrease in another. The result of a correlation analysis is typically expressed through a correlation coefficient, which ranges from -1 to +1. A coefficient close to +1 indicates a strong positive relationship, where both variables increase or decrease together. A coefficient close to -1 indicates a strong negative relationship, where one variable increase while the other decreases. A coefficient close to 0 suggests no significant linear

relationship between the variables. Correlation analysis is widely used in various fields like finance, economics, psychology, and social sciences to identify patterns and guide decision-making. However, it's important to remember that correlation does not imply causation; just because two variables are correlated does not mean that one causes the other.

Regression Analysis

A statistical method for modelling and examining the relationship between variables is regression analysis. In essence, it aims to comprehend the relationship between changes in a dependent variable and changes in one or more independent variables. Finding the mathematical formula that best captures this relationship—which is frequently shown as a line or curve on a graph—is the main idea. By using this equation, we can forecast the dependent variable's value based on the values of the independent variables. Regression analysis, for example, could be used to forecast a home's price (a dependent variable) based on its location and size (independent variables). The analysis not only establishes the direction and strength of the relationship but also sheds light on the extent to which each independent has an impact on the dependent variable. In many disciplines, such as economics, finance, the social sciences, and engineering, regression analysis is used extensively for forecasting, testing hypotheses, and figuring out the underlying relationships in data.

Suggestions

Enhancing BDA Adoption in SMEs

Government initiatives and subsidies can help small and medium enterprises (SMEs) overcome financial barriers. Cloud-based and scalable big data solutions should be promoted to reduce implementation costs.

Investment in Skilled Workforce

Organizations should focus on training employees in data analytics, AI, and ML to bridge the talent gap. Collaboration with universities and technical institutes can help develop industry-specific big data expertise.

Strengthening Data Security and Governance

Robust cybersecurity frameworks and data governance policies should be established to ensure data integrity. Compliance with regulatory standards should be a priority to mitigate risks related to data privacy.

Overcoming Resistance to Change

Organizations should implement change management strategies to encourage data-driven decision-making. Leadership should advocate for data analytics adoption by showcasing successful case studies.

Research Gap

Limited Studies on BDA Adoption in Emerging Markets

The majority of studies concentrate on developed economies, offering little understanding of the difficulties that emerging markets like India face. To learn more about how infrastructure constraints affect BDA implementation in these areas, more research is required.

Lack of Empirical Studies on SMEs and Big Data Analytics

While BDA is actively adopted by large corporations, SMEs face resource constraints. To create cost-effective analytics models specifically for SMEs, more research is required.

Impact of BDA on Sustainability and Green Supply Chains

Efficiency and cost reduction are the main topics of previous research. To evaluate BDA's contribution to sustainable practices and carbon footprint reduction, more research is needed.

Effectiveness of BDA in Crisis Management and Resilience

The function of BDA in handling supply chain interruptions during emergencies like pandemics and geopolitical conflicts has not received much attention. Research ought to look into how supply chain resilience can be improved through predictive analytics.

Conclusion

In conclusion, the research on big data analytics in enhancing decision-making in operations management highlights the trans-formative potential of data-driven insights in optimizing business processes. Big data analytics allows organizations to harness vast amounts of data, enabling them to make more informed, timely, and accurate decisions. By analyzing patterns and trends in real-time, businesses can identify inefficiencies, forecast demand, optimize resource allocation, and improve overall operational performance. The integration of big data analytics into operations management not only enhances decision-making but also fosters a competitive edge in a rapidly evolving marketplace. As organizations continue to adopt and refine these technologies, the role of big data in driving operational excellence will undoubtedly grow, leading to more agile and responsive business strategies. Further study should focus on exploring the integration of emerging technologies, such as AI and machine learning, with big data analytics to enhance predictive capabilities in operations management. Additionally, research on overcoming data privacy and security challenges in big data applications would be valuable.